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THE MUSEUM AND THE SCHOOL

WITH commendable restraint those responsible for the organization of the exhibition of museum publications of educational interest, which was held at University College, London, during June 20–July 15, made no attempt at exhaustive or elaborate display. It was a sampling, for which the material was derived from London and from certain museums of the United States of America. The English contributors included, in addition to the national collections, the London Museum and one of the museums of the London County Council—the Geffrye Museum. Modest as was this effort, it served the purpose, as no doubt was the intention, of provoking thought. The contrast here presented between the methods of the English and the American museums inevitably gave rise to reflection as to the purpose of these great collections of objects of natural, scientific and historic interest, of beauty and of rarity, and the nature of the function which they perform, or might perform, in the life of a community.

As Lord Bledisloe said in his address to the jubilee gathering of the Museums Association, the museum in its original conception was "a fountain of culture alike for young and old, for rich and poor, for layman and expert, adapted to the everyday intellectual and spiritual requirements of the nation as a whole". Without venturing to question the historical accuracy of this statement, we may concur in Lord Bledisloe's dictum and agree with him when he went on to point out, coupling the cinema with the museum, that "as the eye is the most efficacious channel of entry into the mind, there are no more promising educational agents or more powerful stimulants to the imagination than the museum and the cinema". But at the same time, as every educationist is aware, it must not be overlooked that visual impression, whether in adult or child, is but fleeting, unless it finds the mind of the observer already prepared to receive it, and able to link it to material which the mind has already made its own. It is by the nature and the extent of the museum's co-operation with the observer in storing up such a body of assimilated fact that the performance of its educational function must be judged.

In all the important London museums and collections, the institution of guide-lecturers, of special exhibitions, permanent or temporary, illustrating some special phase or problem, and a ready hospitality extended to school visits, have done much to make the public familiar with the character and meaning of the objects in these collections. The services of the lecturers, however, are available for comparatively few of the museum's visitors—those who have the leisure and the opportunity to attend at stated times. For the majority, or at any rate a large proportion, more intimate and more intensive study than is possible in a perambulation of the galleries, even the occasion for arousing interest and stimulating study, must depend to a great extent upon the museum publications. Within the limited space of the exhibition room at University College has been shown a selection of these publications. It was headed by some of the attractive and sometimes striking posters directing attention to the collections in the various museums, which are displayed by the London Passenger Transport Board. Each of these posters, artistic and brightly, but not garishly, coloured, is characteristic of the collection which it announces. The second, an extensive exhibit, consisted of the long range of

picture post-cards and reproductions, mostly in colour, which illustrate almost every branch of science, art and history susceptible of demonstration in a museum.

Of the museum publications in book form, the more technical and advanced did not come within the scope of an exhibition intended to consider only the needs of schools, and the selection shown was confined to the simpler and more popular guides, which do, in fact, carry further the interest aroused by the collections themselves, or by the post-card series. Such a development of interest is to be noted, for example, in the Science Museum series, dealing with topics such as the development of transport, locomotion, navigation, aeronautics and the like.

Reviewing the exhibits from the English museums as a whole, and as an instrument of instruction, the more striking features are the care which has been lavished on the selection and preparation of the various series, the care in production and reproduction, and the scholarship and knowledge which have been drawn upon freely to make known to the general public the character and meaning—scientific, æsthetic or historical—of the wealth of objects displayed in London's museums. It must be apparent, however, that in so far as this material was brought together to illustrate the educational interest of museum publications, it shows strikingly little effort to make readily available for the school a vast amount of material of immense educational value. Except for the Geffrye Museum, which, with the Horniman Museum at Forest Hill, is part of London's educational organization, there is no direct orientation towards the needs of the school. It is here that the contrast with the American museum becomes marked.

Exhibits were shown from five of the larger American museums: the Metropolitan Museum of New York, Boston Museum of Fine Arts and the Brooklyn, Buffalo and Cleveland Museums. It is made abundantly evident that each of these museums regards itself, even if this be not explicitly stated in the terms of its foundation, as having a specific function in the cultural life and educational system of the region in which it stands. Normally, it has an educational division, section or committee, and an educational staff; and it undertakes organized educational work. There is a carefully prepared system of preparatory propaganda. Post-cards, memoranda, and programmes are circulated among the heads of primary, secondary and technical schools and other educational institutions. In some museums, courses are specially arranged to fit in with the curricula, after consultation with the staffs of primary, secondary, and technical schools. They are given by members of the museum staff in special rooms. The museum educational staff is available for consultation by teachers and others interested in education, sometimes at a small fee.

Finally, there are the museum publications, usually a museum journal, which, in addition to notes on recent acquisitions, will contain articles on special groups of exhibits; or, in those museums which specialize in art, dealing with the work of a painter or sculptor, or like topic of artistic or antiquarian interest; while some museums publish a periodical devoted entirely to the interests of school children, and dealing with Nature studies, hobbies and the like. Of a more specifically educational character are sheets or cards of grouped illustrative material, with notes prepared by the museum staff. These are circulated for instructional purposes among the schools. There are also special publications, usually in pamphlet form, or guides dealing with grouped exhibits or special collections.

In general, it may be said that the material which is thus circulated among the schools or made available for their use is scarcely comparable in its printing or general technical character with the publications of English museums, nor, it may be said without offence, does it show the same standard of scholarship. At the same time, it has to be admitted that, having been prepared for a specific purpose and with the educational end in view, it is more certain to reach its mark.

It was abundantly apparent in the material shown at University College that the American museum has not shrunk from taking what it has regarded as its educational responsibility very seriously. This is due in part, of course, to the fact that, whereas the British national and other important collections, owing to their origin, have assumed the character of storehouses of national treasures, and their connexion with the advancement of knowledge has been almost entirely by way of research and not of instruction, in the United States the museums have been founded as, or have become, part of the cultural equipment of the region each serves. Most of them, too, are dependent for their current expenses, not on their

endowment or on support from public funds, but on fees and membership subscriptions; the extent of membership is reflected by the degree in which the activities of the museum meet the cultural needs of its area.

The English institution more nearly comparable with the American museum is the local provincial museum, which grew out of the interests of the local literary, philosophical or antiquarian society. When communications were less easy and other distractions less numerous than they are now, this served as a social and cultural focus for its neighbourhood. Its educational function might well be revived, where it has lapsed, and extended.

While the very different conditions which affect our large museums, in contrast with those affecting American museums, must be recognized, yet a comparison of the two systems of organization in Great Britain and in the United States gives rise to an uneasy feeling that the most is not made in education of the wealth of scientific and cultural material that is available in collections in Great Britain. If it be pointed out in extenuation that a remarkable range of illustrative material from which to select is available for the teacher, the reply surely must be that the teacher is not a specialist; and simple and even elementary as much of the detail in the museum guides and other publications may seem to the specialist, for the layman, however intelligent, they make stiff and uphill reading. The classes and lectures for teachers at the Horniman Museum, and the appointment of liaison officers between school and museum on the inspectorate of the London County Council, were steps in the right direction; but they do not go far enough. To be of lasting value, museum material must be brought into intimate relation with the school curriculum. Intermittent visits to general collections have little permanent instructional value. To suggest that special exhibitions should be arranged in special rooms to meet the needs of schools raises a problem with too many ramifications for discussion here. In the provincial museum, however, education might provide a channel for the further assistance from public funds for which a plea has been put forward. Such matters will no doubt come within the purview of the promised public inquiry.

FUNDAMENTAL CONCEPTS OF ELECTROMAGNETICS

Electromagnetics

A Discussion of Fundamentals. By Prof. Alfred O'Rahilly. Pp. xii + 884. (London, New York and Toronto: Longmans, Green and Co., Ltd.; Cork: Cork University Press, 1938.) 42*s*. net.

HOWEVER gratifying the remarkably rapid progress of experimental science and its practical applications during the last few decades may appear, the immense accumulation of new facts and hypotheses has tended greatly to confuse rather than to elucidate our fundamental concepts, and the edifice of science is becoming like a Tower of Babel in which hosts of skilled workers are busily engaged on their several portions but without plan or architect, and are becoming so divided by specialization as scarcely to be able to understand one another. To such an extent has this confusion grown that we seem to be reverting to pre-Newtonian scholasticism, and many modern men of science are now adopting the speculative and metaphysical modes of thought and expression against which science had to struggle for its very existence in its infancy; so that although humanity is more and more amazed at the achievements of science, it is losing confidence in it as a trustworthy interpreter of natural phenomena and as a guide to human progress.

There is therefore urgent need for a comprehensive review of our fundamental concepts, and Prof. O'Rahilly deserves our cordial thanks and admiration for the energy, skill, and courage with which he has undertaken this formidable task. Within the space available for this review, it is impossible to do more than indicate the immense field covered in this large volume, one of the most interesting and valuable features of which is the collection of quotations from the greatest authorities which reveal the large divergences of opinion which have always existed between them, even when agreement on most fundamental principles was supposed to prevail.

The majority of students, at least in Great Britain, have been brought up on the Maxwellian theory, involving the Faraday concepts of electric and magnetic fields in a medium, and are now being converted to the doctrine of relativity; but the author reminds us of the great body of theory built up by the Continental physicists, Poisson, Gauss, Ampère, Neumann, Riemann, Weber and Lorenz, and their successors, Voight, Liénard, Schwarzschild and Ritz, based on action at a

distance between discrete charges and the assumption first made by Riemann in 1858 of a finite velocity of propagation approximating to that of light. He points out that not only did they arrive at results in accordance with those derived from the Maxwellian equations, but also that they were anticipatory of the modern electron theory, and therefore more in accord with recent experimental developments. The Maxwellian concept of electric displacement in space, involving a basic medium or ether, was greatly disliked by Continental physicists, and only secured their assent for a short period after Hertz's brilliant experimental verification of Maxwell's theory of electromagnetic propagation; so that the discovery of the electron and the rapid advance of corpuscular physics provided a welcome excuse for reversion to their earlier ideas.

As the author is professor of mathematical physics at University College, Cork, the volume is naturally highly mathematical; but readers with very little mathematical ability will find the discussion of various theories and the conflicting views of high authorities most interesting and thought-provoking—so much so that it may lead someone to suggest a new fundamental hypothesis which will at last satisfy not only quantitative but also intellectual needs. The very fact, as is clearly demonstrated in the volume, that widely divergent fundamental concepts may lead to almost identical formulæ which give close quantitative agreement with experimental measurements, shows that such quantitative agreement is no proof of the validity of the concepts; so that mathematical reasoning must be supplemented by physical insight.

Only two physical hypotheses at present hold the field: (1) the emission, or what the author calls the ballistic, hypothesis, which was definitely adopted by Ritz; and (2) that of a medium, adopted by Faraday and Maxwell; since the old action-at-a-distance theories and the modern doctrine of relativity have been concerned only with obtaining quantitatively accurate general formulæ, regardless of any agency by which bodies or charges act upon one another. In this the latter resemble Newton's theory of gravitation, but although Newton expressly refused to promulgate any hypothesis, he emphatically stated that the idea "that one body may act upon another at a distance through a vacuum without the mediation of anything else by and through which their action and force may be conveyed from one to another—is to me so great an absurdity that I believe no man who has in philosophical matters a competent faculty of thinking can ever fall into it". This certainly expresses the feeling of every physicist who does not accept the dictum that mathematical formulæ represent the only true reality, and the belief in and search after the mediating agency is bound to persist.

Prof. O'Rahilly, while accepting the validity of Maxwell's equations and the existence of an ether, has definitely discarded the concepts of electric and magnetic fields, and takes his stand on the Liénard–Schwarzschild force formula, which appears to be equivalent to the simple vector formula given by the present writer in NATURE of December 3, 1938, except that the former contains a factor of $\frac{1}{2}$ in the third term, which seems to conflict with the Neumann inductance formula, and two additional second order terms in v^4/c^2 derived from the assumption that longitudinal forces are also propagated with the velocity of light. This scarcely seems consistent with the deduction from the energy of a moving electric field that its inertia is only of a transverse character, but the author claims that these terms are necessary for reconciling the formula with experiment.

In spite of his own mathematical powers, Prof. O'Rahilly is far from over-estimating the value of mathematics; and his comments on some of the most elementary mathematical concepts, including dimensions, as well as on the modern ideas of space-time, are interesting and amusing. In order to avoid the prejudice against the concept of 'absolute' motions, he has adopted the Greek word *schesis* for a basic framework; and he claims that the only truly consistent relativistic theory was the ballistic or corpuscular theory of Ritz, and that the modern doctrine of relativity is fundamentally schesic. That he is justified in this claim seems clear from the constant recurrence of the term v^2/c^2 in the Lorentz transformation formula (which the author points out was enunciated by Voight in 1887) and so many relativistic formulæ, which term, like the v and v^4 in the Liénard–Schwarzschild force formula, can have no meaning unless such a framework or schesis is implicitly assumed.

Although probably every reader of this volume will find himself alternating between hearty agreement and strong disagreement with Prof. O'Rahilly's various criticisms and conclusions, his wide outlook and critical survey of the various theories entitle his views to respectful consideration. Whether they are justified or not must be left for the future to decide, but we can heartily endorse Prof. Conway's concluding remark in the foreword, that the volume "is more than a review of existing knowledge, it is a courageous attempt at reconstruction; and if we do not always agree with the writer, he certainly makes us reflect. I recommend this book to every serious student of Electromagnetics".

C. V. DRYSDALE.

CHEMICAL REACTION IN THE ELECTRIC DISCHARGE

The Electrochemistry of Gases and other Dielectrics

By Prof. G. Glockler and Prof. S. C. Lind. Pp. xiii + 469. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 30*s*. net.

THE appearance of this first book on the electrochemistry of gases will be welcomed by a wide circle of physicists and chemists, who will also remember that one of the authors has written the first book on a related subject, namely, reactions initiated by α-particles. This book is the more welcome because of all the chemical writers on electrochemistry, none since Löb in 1905 appears to have found the part of the subject relating to gases of sufficient importance to devote to it more than a trivial portion of a book, despite the very extensive literature on the subject. Physicists writing on discharge phenomena, with the exception of Stark in 1902, are even more disappointing, for all the later writers have either omitted to mention the subject or dismissed it in a few lines.

The book was written at the request of the Committee of Electrical Insulation of the American National Research Council, and attempts to cover the field "considering all forms of electrical discharge and all types of reactions"; it contains, however, no more than three pages relating to industrial applications, vitamins, insulation, and lubricating oils.

There are three main sections in the book. Part 1 is entitled "Typical Reactions in Various Forms of Discharges"; its theme is illustrated in 139 pages by what the authors describe as a "quite arbitrary" selection of reactions which have been examined in one or more of the known types of discharge, including slow and fast electron beams. The last section is devoted to an account of the properties of molecular fragments as observed *outside* the discharge in which they are formed.

Part 2 deals in 190 pages with "Chemical Reactions in Electrical Discharges" and attempts to cite "most of the reactions that have been studied", which claim for the most part is well substantiated. The formidable task of arranging the very heterogeneous material from some 656 references in this section alone has been dealt with by considering the reactants in ascending order of atomic weight; in some cases, this has led to the dissemination of the information concerning the formation and decomposition of a given substance through several chapters.

Part 3 is entitled the "Physical and Theoretical Aspects of Discharge Reactions". The first three chapters deal with electron affinity, ion mobility, and a list of the ions observed in discharges. Then follow two interesting chapters on ionization produced by reaction, and on sputtering. The book closes with a chapter on the mechanism of discharge reaction.

Considered as a whole, the great value of this book derives from the fulfilment of the authors' aim to compile the vast mass of experimental data so as to facilitate the comparison of the various forms of discharge reaction, both amongst themselves, and with reaction initiated in the same systems by other agencies. This will be invaluable to all investigators of discharge phenomena, whether chemists, physicists or engineers. It should be a powerful stimulant to further exploration of the field, both experimentally and theoretically; and it may be that even the industrialist will be attracted to consider the possibilities of some of the remarkable syntheses that are described. It is, however, difficult not to feel a slight and perhaps ungracious sense of regret that, having such familiarity with this enormous collection of information, the authors have not essayed a more critical commentary on the relative value of their material.

Only fourteen pages are allotted specifically to the chapter on the mechanism of reaction, although most of the attempts to formulate a theory are mentioned either there or elsewhere in the book. The accounts of the various theories are, however, rather uneven; for example, Kirby's quantitative theory of positive column reaction is barely mentioned, whilst much of Warburg's work is given in detail. The authors themselves have chosen to discuss reaction mainly in terms of the ion cluster theory for reasons of "simplicity and personal acquaintance". The statistical approach to the quantitative theory of discharge reaction is, however, a little surprisingly dismissed without even formal statement, for the unproved and possibly irrelevant reason that it is impossible in this way to explain certain facts concerning reactions initiated along α-particle tracks.

The book is beautifully produced, readable, and illustrated with numerous clear diagrams; there are good author and subject indexes.

R. WINSTANLEY LUNT.

GENETICS IN THE GARDEN

The Genetics of Garden Plants

By M. B. Crane and W. J. C. Lawrence. Second edition. Pp. xxi+287. (London: Macmillan and Co., Ltd., 1938.) 12*s*. 6*d*. net.

THAT a second edition of this work should have been called for within four years of the appearance of the first shows that it has met a definite need. Nor is this surprising; for the dimensions to which the study of scientific plant breeding has attained offer one of the most spectacular examples of the rapid rise of an applied science based upon a simple initial discovery.

It is not much more than thirty years ago that Biffen declared plant breeding to be a game of chance with the odds on the plant. To-day, thousands of plant breeders all over the world are in a position to define their aim and to pursue it with every prospect of success. The majority of these are, of course, dealing with farm crops of fundamental importance to mankind—with cereals, grasses, cotton and the like—crops where even a very small improvement in quality or quantity is enormously magnified by the vast acreages involved. With this aspect the authors are not concerned. They have confined themselves to the products of the flower and vegetable garden, with the inclusion of fruit trees.

A brief and clear introduction to the principles of genetics and cytology involved is followed by three interesting chapters on flowers and vegetables. Special attention has been paid to such species as have been more intensively studied—to the sweet pea, the stock, the dahlia and the primula, and among vegetables to the tomato, the potato and the garden pea. The matter is presented in a form which allows the reader to obtain an idea of the successive changes that have occurred under continuous cultivation, while at the same time he is given an insight into the chemistry of flower colour and brought to realize the importance of polyploidy as a factor in connexion with 'improvement'.

A considerable part of the book is devoted to fruit trees and bush fruit, and is largely based upon the well-known experimental work carried out at the John Innes Horticultural Institution by the senior author. The genetical analyses of the more important cultivated forms are followed by illuminating discussions on bud sports, sterility and incompatibility—topics all important for the grower of fruit. The final chapter, on the origin of new and improved varieties, should prove of deep interest alike to the student of evolution and to the practical grower. The recently discovered colchicine treatment for the induction of polyploidy is alluded to, perhaps too briefly in view of its extraordinary promise. Doubtless the authors will tell us more about it in their next edition when more data are available. It is suggested also that they might give some account of the work with X-rays and radium which is leading to the production of interesting novelties in various plants to-day.

Altogether this is a most interesting and valuable book, excellently produced and illustrated. To the practical grower its value is obvious, and nowhere else will he find so clear an exposition of the principles underlying his craft. It should make an even wider appeal to the amateur horticulturist who is not merely content to admire the beauty of the plants he grows, but wishes to learn something of their nature and of the causes that have brought them into being.

THEORIES OF VISION AND HEARING

Theories of Sensation

By Dr. A. F. Rawdon-Smith. (Cambridge Biological Studies.) Pp. xiii+137. (Cambridge: At the University Press, 1938.) 10*s*. 6*d*. net.

THIS excellent book deals with sight and hearing and does not include any reference to touch, taste and smell. Dr. Rawdon-Smith gives the reason for this in his introduction. He writes, "It would be safe to say that no theory of general sensibility has yet been proposed which is able to describe the available data. . . . We may note in the fields of olfaction and gustation not that the theoretical position is insecure, but simply that no theoretical position exists."

The four chapters on vision refer to the following subjects: Chapter i to the formation of the retinal image; Helmholtz's theory of accommodation and the pupil reflexes. Chapter ii alludes to the duplicity theory of von Kries, the Purkinje phenomenon, the photochemical properties of visual purple, dark adaptation and night-blindness. Chapter iii refers to the discrimination of intensity, the critical fusion frequency, the acuity of the eye at different

light intensities, the size of the foveal cones, vernier acuity, the frequency of the impulses in the optic nerve and the various theories of visual acuity. Chapter iv contains an account of colour vision, the brightness of the spectrum, colour mixture, colour-blindness, the choice of primary colours, simultaneous and successive contrast.

Commenting on these first four chapters, Chapters i and ii are introductory to the ones which follow. Chapter iii is specially good and gives a very clear picture of the rival theories of visual acuity. The position is made interesting and understandable. Chapter iv contains a good account of the theories of colour perception.

Turning now to the ear. Chapter v deals with the anatomy of the ear: the production of summation and difference tones, the functions of the ossicular muscles, the cochlea, the organ of Corti, the mode of stimulation of the hair cells. Chapter vi contains an account of Helmholtz's resonance theory and also of the theories of Ewald and Boring, experimental deafness in animals and boiler-maker's deafness in man, the evidence of models, the evidence of the phase-change beat, the intensitiveness of the ear to the relative phases of tones, the Wever Bray phenomenon, the volley theory, the perception of pitch, the rate of conduction of the auditory nerve fibres, the cochlear response and the auditory tract potentials for a change of phase. Chapter vii deals with methods of producing changes of intensity, the sensitivity of the ear to intensity differences, the sensitivity of the cochlear response to intensity differences, and the probable way that differences of intensity are conveyed to the brain.

The reviewer's opinion on these chapters may be briefly explained as follows: Chapter v gives a good introduction to a description of the functions of the ear. Chapters vi and vii state clearly, and in a manner which is easily understood, the present position with regard to the resonance theory, the volley theory and the Wever and Bray phenomenon, and a number of other points which are very intimately connected with the physiology of hearing.

The book is an extremely successful attempt at epitomizing the very varied theories of vision and hearing, and for that reason alone should be read by all who are interested in the mechanisms of sight and sound. H. HARTRIDGE.

THE CULTURE OF ORGANS IN VITRO

The Culture of Organs

By Alexis Carrel and Charles A. Lindberg. Pp. xix + 222 + 38 plates. (London: Hamish Hamilton, Ltd., 1938.) 18*s*.

THE Carrel-Lindberg perfusion method represents one of the most important technical advances in biology which has been made in recent years, so that the present volume, in which the authors describe in detail their apparatus, its mode of operation and the experimental results obtained up to date, is extremely welcome.

The apparatus is designed to maintain a sterile, pulsating circulation of nutritive fluid through isolated organs. It consists of two main parts: the perfusion pump, which contains the organ and perfusion fluid, and a mechanism for creating and transmitting a pulsating gas pressure to the fluid in the pump. The mechanical details of the apparatus are complicated, but are clearly described and profusely illustrated with good diagrams and photographs.

Many culture media have been tried and are grouped into two main classes: natural and artificial. The former consist of blood serum diluted with Tyrode's solution, to which may be added such substances as Witte's peptone, insulin, hæmoglobin, etc., while the latter, which vary widely in composition, contain either no serum or only a small proportion. In order to detect changes in *p*H during the course of the experiment, phenol red is always added to the perfusing media.

One chapter is devoted to the preparation of the tissue to be perfused. "The goal of the technique is to transplant an organ into the organ chamber without any damage to its blood vessels and without infection", a goal which demands scrupulously aseptic precautions and no small surgical skill. When the organ has been suitably prepared, it is inserted into the organ chamber and the blood vessels are connected with the perfusion pump by a system of canulæ. The entire apparatus is then placed in the incubator.

One of the major difficulties of the method is to maintain asepsis, which is rendered unusually difficult by the large volume of the tissue and perfusion fluid, by the complexity of the apparatus and by the extensive manipulation involved. Rigid aseptic and antiseptic measures are therefore necessary.

Many different organs and structures have now been successfully perfused for periods up to forty days, and a comparative study has been made of the effects of different natural and artificial media on the histology and functional activity of the

organs. "Thyroid glands, ovaries, hearts, kidneys and pancreas were found to maintain or to modify *in vitro* their functional activity according to the chemical composition of the perfusing medium." For example, the addition to the Tyrode solution of only 5 per cent serum allowed parts of the thyroid to survive for several days, the addition of 10 per cent kept the gland alive and almost unchanged for more than a week, whilst 80 per cent produced hyperactivity of the organ as compared with the uncultivated control from the same animal. The thyroid was maintained in a healthy state for several weeks by transferring it every week to another pump with a fresh supply of diluted serum. The photomicrographs of sections of perfused organs present convincing evidence of the healthiness of the tissue even after prolonged cultivation.

Normal functioning of the perfused organs has also been demonstrated. Thus iodine is secreted into the perfusion fluid of the thyroid, and the secretion can be increased by adding thyrotropic hormone to the fluid. Similarly, the perfused pancreas has been shown to secrete insulin.

The number of problems to which this ingenious method can be applied is almost unlimited, and it is to be hoped that the Carrel–Lindberg technique will be introduced into many physiological and medical laboratories. The chief obstacles to its more general use are its difficulty and the complexity of the apparatus required. Dr. Carrel encourages the reader by assuring him that the method is not so difficult as it looks, but admits that it cannot be learned from a book; it should be studied in a laboratory where it is being practised.

This book should be of the utmost value to the beginner who, having acquired the technique under expert guidance, is endeavouring to establish it in his own laboratory. Moreover, although primarily a technical work, it contains matter of considerable biological interest and can therefore be recommended to the general scientific reader.

H. B. F.

THE LEPCHAS OF SIKKIM

Himalayan Village:
an Account of the Lepchas of Sikkim. By Geoffrey Gorer. Pp. 510+32 plates. (London: Michael Joseph, Ltd., 1938.) 25*s*. net.

MR. GORER, who had already proved his mettle as an observer in "Africa Dances", is now, as Prof. Hutton points out in his introduction to this book, a recruit to the ranks of serious anthropologists. He is fortunate in that his first essay in ethnographical study deals with a people, the Lepchas of Sikkim, whose country hitherto has been virtually closed to Europeans. In 1936 he accompanied Major C. J. Morris to Sikkim, and after two months spent at Kalumpong in study of the language, settled with him, under favour of the Maharajah and with his approval as their passport, in the village of Lingthem, which comprises a population of one hundred and seventy-six individuals. Mr. Gorer's book, and the account of the same village published recently by Major Morris, thus give from two different points of view what in sum is a comprehensive picture of a country and a culture, which though changing, up to now have been completely outside European influence and contact.

The author has treated his subject-matter from three different points of view, to each of which he devotes a section of his book. In the first he deals with the material and formalized aspects of Lepcha society—its framework; in the second he covers the mainly unformalized aspects of their life; and in the third he presents the life-history of certain individuals who, it is to be presumed, may be regarded as typical.

Certain aspects of Lepcha life have impressed him more strongly than others as characteristic; and it is under discussion of these in his attempts at their evaluation that the author makes, apart from his purely descriptive work, his main contribution to anthropological thought—a contribution which gives his book an additional claim to the serious attention of the anthropologist. Of these characteristics one is the remarkable lack of aggressiveness in the Lepcha character. His explanation which attributes this lack to the swamping of personality in the group feeling is discussed by Prof. Hutton in his introduction with some reserve, but not unsympathetically.

A further characteristic, to which the author makes extended reference, is the obsession of the whole community by sex, a point which also impressed Major Morris. Here again Prof. Hutton has raised an interesting question by asking whether decline of population and sterility are cause, or effect, of this obsession.

Finally, there is the cynical attitude of the Lepchas to their own religious beliefs, associated with an optimism which is qualified by a complete lack of belief in their own efforts and their future.

BUSH FIRES IN VICTORIA

THE drought of the early summer, which affected all south and south-eastern Australia, was followed by a heat wave in the first fortnight of January which reached sufficient intensity to reduce leaf litter in the forest to tinder dryness. The usual firing by cattle graziers had been in progress for some months over all the rough mountain grazing land which lies to the north of the prime forest belt. Northern and north-western winds of great force set in during the first week of January and fanned the sporadic fires into conflagrations which swept the country wherever forest existed and also much of the cleared grass lands where the stock had left enough herbage to carry a fire.

Forest losses were severe in New South Wales, and in the Australian capital territory 3,600 acres were burnt; this represents a quarter of its plantation area. South Australia suffered also, but proportionately less, for her plantations are not exposed to the same external fire hazard. Tasmania escaped at the time that the fires were at their worst on the mainland, but towards the end of January and early February, serious fires broke out in that State and severe losses were sustained.

The greatest losses occurred in Victoria, where by the end of that first fortnight of January 5,038,600 acres of forest were burnt over, sixty-seven saw mills and approximately six hundred houses and cottages were destroyed and seventy-one persons lost their lives. The full extent of the loss in timber cannot be gauged, but the amount in the easily accessible areas has been assessed, and this reaches the alarming total of 2,070,000,000 superficial feet in the round. It is estimated that 916,000,000 superficial feet of this killed timber can be salvaged. The dead timber in less accessible areas of burnt ash and alpine ash forest cannot be salvaged.

Victoria's loss amounts to a national disaster, for the chairman of the Forests Commission, speaking at a representative meeting of timber men last year, stated that supplies of ash timber would last less than twenty years.

It will be seen that already the overcutting of the forests had brought the industry to the point where future supplies of logs were becoming a very serious matter, and now the greater part of the timber has been destroyed by fire. Victoria's loss is so severe that it is difficult to see how the industry can fail to sink into insignificance once the salvaged timber has been converted. Investigations are now being made to see whether it is possible to prolong the period of utilizing burnt logs. It is a question of preventing fungus attack, and is therefore a difficult matter.

[*Photo: Forests Commission*

Fig. 1.

VIRGIN MOUNTAIN ASH FOREST, CUMBERLAND VALLEY, VICTORIA.

The genus *Eucalyptus*—the gum tree—of which all the burnt forests consist, is in the majority of cases difficult to kill outright. After a very severe fire has passed through, burning all the crowns, epicormic branches spring from branch and bole and restore the leaf area, and so life is maintained and the greedy branches on the limbs grow into mature branches, new crowns are formed and the greedy branches on the boles fall off. A month after such a fire as has been experienced, the bush

[*Photo: W. Russell Grimwade*

Fig. 2.

NATURAL REGENERATION OF ASH AT NOODJEE, VICTORIA, FOLLOWING THE 1926 FIRE.

is sprouting with green tufts of leaves except—and this is what makes Victoria's case so serious—the species composing the forest belonging to the ash group of gum trees. These are *Eucalyptus regnans*, mountain ash, and *Eucalyptus gigantea*, alpine ash; there are three others, but they are not of the same milling value. These ashes do not renew their leaf surface by means of epicormics and so are killed outright by any fire which attains such an intensity as to burn the crowns. A great part of the Victorian forests consists of these ashes, and the bulk of the sawn timber of that State is ash. Fig. 1 shows a type of forest of mountain ash before the fire. The trees attain heights of more than three hundred feet, and the volume per acre on first quality sites is only beaten by such forests as virgin Douglas fir. So while in the coastal regions of New South Wales great conflagrations took place at the same time as the ash forests were being destroyed in Victoria, the trees will recover, and though greatly injured and yielding as they will inferior products, will reform a forest and perpetuate it.

In the ash belts of Victoria the only hope is that sufficient seed will have been shed from the capsules on the burnt trees, some of which will not have been consumed and would at that time of the year be ripe but closed and would open after the fire had passed by. Experience of past fires has shown that a very fine regeneration of ash follows an intense fire. The seed falls on a good seed bed and has an even chance with all weed growth that springs up in the ashes. Some of the best regeneration of mountain ash has occurred in this way. Fig. 2, Noodjee forest, shows what may be expected twelve years after a very bad fire. The big log on the ground was a tree killed in the conflagration that wiped out the forest in 1926; the seed was shed, good rains occurred and the excellent regrowth, which the Forests Commission has carefully thinned, resulted.

All then is not lost if the trees in the forests, though killed, are capable of still reproducing themselves. It means a long wait, for on present knowledge it takes sixty to eighty years to make a mill log. That is not all, for during this long period there is serious danger that an uncontrollable fire will sweep the forest again. This is what

[*Photo: Forest Commission*

Fig. 3.

WIND AND FIRE DAMAGE IN MOUNTAIN ASH STAND, TANJIL RIVER, VICTORIA, JANUARY 1939.

has occurred in many parts of Victoria, including the fine regrowth shown in the picture. What happens then is complete destruction, for the young trees forming the regrowth are too young to bear seed and there are no old seed trees to help, and so the forest becomes bracken land, which can only be reforested by planting—a very expensive business at Australian rates of wages.

Fig. 3 shows the effect of fire on good regrowth. The Forests Commission has been engaged in tending those fine areas of regrowth and in protecting them from fires. Last year, some £600,000 were spent by the Commission on such work, and fires have wiped out the greater part of the asset. Much of the money has gone into roads and permanent improvements of a capital nature and their value will remain if the forests are regrown and protected from fire.

This brings up the question: Are these fires inevitable? If the answer is yes, then to spend more money on forestry in Victoria is not justified. There is no doubt that periods of intense dryness, accompanied by high winds, recur at comparatively short intervals. They vary in degree, but too much credence should not be given to the statements that have been published that January 1939 was the worst ever experienced since white settlement of Victoria. Well-equipped meteorological stations are still uncommon in the country districts, and the evidence of old inhabitants is notoriously unreliable in all matters; degrees of heat and strength of wind are not phenomena capable of easy estimate. Probability points to intense fire conditions having occurred many times and likely to recur at least five times in the rotation of an ash forest.

This being so, how is it that there are any ash forests at all? The tree is killed by a severe fire and the regrowth can scarcely escape destruction with such a periodicity of five years. The fact that virgin forests existed up to the recent fire in Victoria is evidence that catastrophic fires did not occur before white settlement. The trees of the virgin forest are far older than the settlement of Australia, and apart from this evidence there are several facts which make it quite certain that the black man's fires were of small nature. The late Sir Baldwin Spencer, discussing this matter with the writer, said that the aboriginal only burnt to provide fresh grass to attract kangaroo and wallaby and, owing to his primitive weapons, his aim was to burn very small areas which the clan could surround when the marsupials were feeding. It is probable that no fires were lit for this purpose in the virgin ash forest because to start a fire in such forests would be difficult and the results would not be so successful for the aboriginals as in the grassed savannah forests adjoining.

It is clear that fires have increased in intensity since white men began to develop Victoria. The early history is interesting in this regard, for it shows what difficulties were encountered by the settlers who were given country to open in the ash belt. They found it most difficult to get a 'good burn' after they had felled the timber. It was only when many holes had been carved out of the forest and a very dry period occurred that a sufficient 'face' of fire was established to sweep through the green forest.

It was not until 1851 that a great conflagration was lighted, and this was so unusual and the results so devastating, that it is known to-day as "Black Thursday, the Day of Terror". Since then, fires of great intensity have occurred at intervals which have become shorter.

The great fires run as follows: 1851, 1898, 1926, 1932, 1939, and of these, the last was only the most serious because of the greater loss of life owing to the country being more opened up and, in consequence, more peopled. The evidence is quite clear that the effect of settlement has been to increase the fire hazard enormously and that forests which were once practically immune from fire became first vulnerable as the face of the conflagration increased and were finally burnt through. The opening up of virgin forest by logging operations contributed largely to the vulnerability of the forests, and the fire prevention organization of the Forests Commission, while adequate to deal with all fires that broke out within the forest reserves, found itself impotent against the raging fires which swept in from Crown lands outside.

After the disasters of 1926 and 1932, fire legislation was tightened up, and to-day the fire prevention laws of Victoria are sufficiently stringent, if enforced, to make fire setting a very risky business in any accessible part of the forests.

The education of the public has been developed to an extent which ensures that everyone is warned against the careless use of fires. The meteorological service sends out through the broadcasting network warnings when the temperature and evaporation are reaching dangerous levels. Roads, tracks and breaks have been cut through the forest and aerial patrols report the outbreak of any fire. Every year by notice in the *Victorian Government Gazette* all areas of land subject to fire hazard are proclaimed as coming under the bush fire laws. These areas cover all Victoria except the inland Mallee country. All these laws and precautions and all this propaganda did not save the position in January. The Government appointed a Royal Commission to inquire into the causes and effects of that fire and to recommend remedies; its report is not yet published so the matter is still *sub judice*. Comment must, therefore, be restricted.

It is quite clear that no internal organization within forest areas can prevent a repetition of the disaster of January 1939. The only way to prevent it is to give the Forestry Commission of Victoria, not only the legal power, but also the departmental machinery and equipment to control fires in the open Crown land leased to graziers beyond the boundaries of the forest reserves. How wide a protection belt is needed must depend on the topography. Where a range of mountains occurs in the Crown land, then it must be included if it is twenty miles away, for it has been definitely established that fires are started on plains 3,000 feet below by bark and debris blown from trees burning on a range twenty miles away. The wind reaches hurricane force, and even on the plains it reached 40–50 m.p.h. at the height of the fire on January 14. Where the forest reserve is surrounded by plain country, the protective belt may be safely made narrow. Everywhere throughout the protection belt roads must be made and look-out towers erected. Instant detection is the first step, and then immediate suppression. Wireless is a valuable aid to both these services, making communication possible between the towers, the fire suppression gang and with headquarters. All this is going to cost a great deal of money, the failure to provide which in the past is the main reason for the disaster. Conflagrations are not inevitable; the forest departments of Australia have shown this in the case of fires starting within their forests, and all that is necessary is to extend the foresters' jurisdiction and operations to cover the land held under grazing occupancy outside.

The tragic loss of life has brought the question of safety measures very much into the foreground. Dug-outs proved very valuable to forest mill-hands and others during the last outbreak and many lives were saved through them.

REACTIONS WITH MONOLAYERS AND THEIR BIOLOGICAL ANALOGIES

By Prof. Eric K. Rideal, M.B.E., F.R.S., and Dr. J. H. Schulman,
Department of Colloid Science, Cambridge

THE film technique permits us not only to examine the progress of chemical and enzyme reactions in monolayers but also to investigate mixed films, for example, lipo proteins, and the effects of injecting various reactants beneath monolayers. It has been found[1] that the reactions of monolayers of lipoids such as cholesterol with substances injected into the substrate are dependent both on the nature of the polar group and on that of the hydrocarbon 'tail' of the injected reactant. Similar conclusions can be drawn as to the extent of reaction with monolayers of proteins. The possibilities in this case are somewhat more complex, for the protein monolayer must be regarded as a triplex system, the extended polypeptide chains separating an upper hydrophobic layer from a lower hydrophilic one, the latter containing the polar groups of the side chains of the protein.

It is possible to separate the various factors which govern the adsorption by, or the penetration into, a monolayer of such a structure. These naturally include not only the usual criteria of water and oil solubility but also more specific terms, such as the interaction of polar groups and special steric configurations which permit of adlineation of specific hydrophobic portions of the molecules. We include also not only the effects produced by changing the number and spacing of polar groups in the reacting molecule, that is, multiple point contact, but also the structure of the hydrophobic portions which may or may not be conducive to close packing of the reactant in a sheet below the protein monolayer.

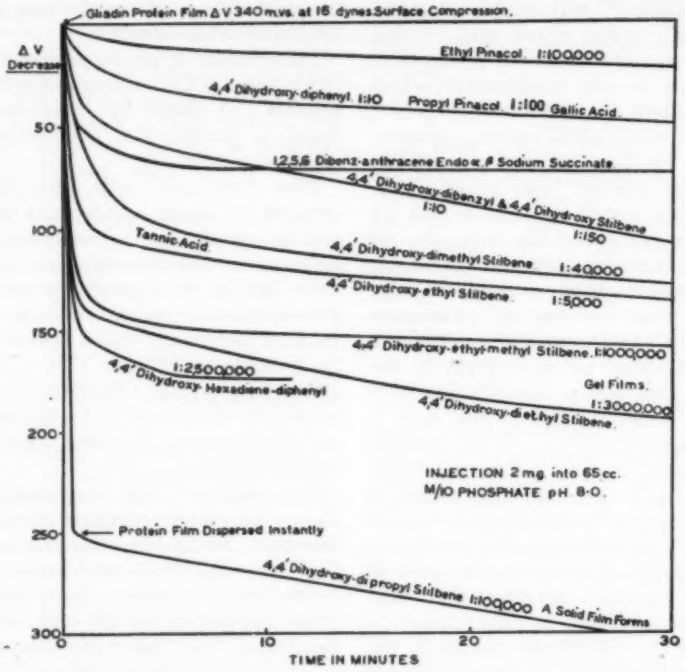
We have examined *inter alia* a number of œstrogenic compounds[2] of which the *p.p'*-dihydroxy diphenyl hexadiene and stilbene derivatives form a definite series in which the ratio of hydrophobic to hydrophilic portion could be varied. These show marked differences in œstrogenic activity with a sharp maximum at *p.p'*-dihydroxy diphenyl hexadiene and *p.p'*-dihydroxy diethyl stilbene or dibenzyl. The œstrogenic activity falls some thirty to fifty-fold on increasing or decreasing the number of CH_2 groups in the molecule by two.

In the accompanying figure are shown the extents of interaction as measured by the change in surface potential with a gliadin monolayer on a substrate buffered at *p*H 8 on injection of 3 mgm./100 c.c. of reactant into the substrate. The œstrogenic activities of the various compounds are likewise included. It will be noted that reaction sets in rapidly, but equilibrium is only finally attained after some 15–20 minutes, and

that there is a parallelism between the œstrogenic activity and the protein adsorption except in the first and the last members—points we shall refer to later.

We observe that in apparent conformity with Traube's view there is a marked increase in adsorption with increase in the number of CH_2 groups in the molecule, and that this adsorption is cut down by the insertion of polar groups. This effect is clearly exemplified in comparing the diethyl stilbene or dibenzyl compounds with the corresponding pinacols. If, however, reactive polar groups, for example, the phenolic hydroxyl, had been inserted instead of the primary alcoholic reactive polar group at the chain end penetrate monolayers and biologically possess lytic activity: if a second spaced polar group be inserted the lytic and penetrating properties are lost, the substance becomes an absorbant, is packed into the double layer beneath the film, and biologically acts as an agglutinating agent.

Another significant biological similarity has been noted when we measure the extent of penetration of a series of substances containing identical hydrophobic 'tails', for example, a C_{12} chain, but with different head groups into a monolayer of a typical lipoid such as cholesterol. In all cases the



groups in the methyl or ethyl pinacols, a marked increase rather than a decrease in adsorption would have been observed, for the following compounds react in order of increasing adsorption on both amine and protein monolayers: cresol, gallic acid, digallic acid, purpurogallin and tannic acid. This order is, however, reversed to give a normal Traube series when these substances are injected under a relatively non-reactive monolayer such as a long-chain acid. A wide variety of substances have been examined from this point of view, namely, their extent of interaction with protein monolayers, and it has been found that there is a direct parallelism between their extent of interaction and their lethal action on Paramecia.

We note a further biological analogy in that long-chain hydrocarbon derivatives with one extent of interaction, as measured by the increase in surface pressure caused by the injection of 0·33 mgm./100 c.c. under a film of cholesterol, originally extended to 40 A.^{2} per molecule, is found to be closely parallel to the hæmolytic activities and lethal activities on Paramecia of these substances.

These latter can be placed in order both of monolayer penetration and of biological activity as follows:

$$\overset{+}{R}NH_3 > RSO_4' > RSO_3' > RCOO' > RN(\overset{+}{C}H_3)_3 > RNH(\overset{+}{C}H_3)_2 >$$ Bile acids.

We may conclude that the most reactive group in the protein macromolecule is the amino group since the -NH-CO- group is poorly reactive, a

point of some interest when we examine the reactions of lecithin and of cephalin. This order of head group reactivity receives confirmation when penetration into monolayers containing these head groups is examined, that is, on inverting the system. When we compare the reactivities of a series of long-chain compounds with identical head groups, it is found that biological activity and film penetration commences at about C_8 when attached to a very reactive head group and reaches a maximum value at about C_{18}. It is interesting to note that it is not necessary for all the carbon atoms to be in the form of a chain; they may be enclosed in ring systems; thus activity commences with diphenyl derivatives. Optima are found in the bile acids, stearic acid, diethyl stilbœstrol and benzpyrene oxidation products.

We have referred to the modification which must be introduced into either the Overton Meyer or Traube concepts of biological activity, namely, lipoid solubility or capillary activity necessitated by the concept of specific head group interaction. We see that a definite limit is also set to the hydrophobic portion of the molecule, for we must take into account both the decreasing solubility in the aqueous phase causing difficulty in transport and also the ease of adlineation or packing having an optimum of C_{16}. We find that a new phenomenon, as exemplified in the figure, sets in with long chains, namely, dispersion of the monolayer, most marked in the case of 4,4′-dihydroxy dipropyl stilbene. It is possible that this phenomenon of film collapse and dispersion may be a generally important factor in setting the upper limit to the chain length or, more generally, the capillary activity of homologous series of biologically important substances, such as anæsthetics. This dispersion of protein films may have biological counterparts in adsorption on specific portions of the cell surface similar to the hæmolytic activity of long-chain compounds such as oleic acid, which readily disperses protein films. Another interesting parallelism has been observed in the surface reactivities and œstrogenic powers of two isomeric compounds (*p.p′*-dihydroxy diphenyl hexane), one being markedly differentiated from the other in both protein adsorption and in œstrogenic activity. Here models indicate that the *trans* arranged rings can pack laterally with one another in sheet form much more readily and with a greater degree of adlineation than the *cis* structure, imparting stability to the adsorption complex formed with the former substance.

In advancing these somewhat novel principles, based upon the hypothesis of a parallelism of film reactions and biological activity, it is desirable to point out exceptions. It is found, for example, that the pinacol 4,4′-dihydroxy propiophenone is a much more effective œstrogenic agent than either its paramecidal activity or adsorption on protein monolayers would suggest. The view might be advanced that on certain living tissues it can be partly converted by enzymatic reaction to either the extremely active 4,4′-dihydroxy diphenyl hexadiene or to dihydrostilbœstrol. Another interesting exception is to be found in desoxycholic acid, which is the only hæmolytic agent in the bile acid (*c.* 1 : 550) series and is likewise poorly lethal on Paramecia. It is unreactive to films of protein, cholesterol and glycerides, and in fact a specific interaction with fatty acids is involved, an observation which may be of importance in considering the emulsifying and transporting properties of the bile acids in the intestine.

This method of attack permits us to investigate the nature of the coatings of cells of unicellular animals and plants by examining the effects of lipoid or protein film penetrating or adsorbing substances on them.

Thus both red cells and Paramecium are affected by lipoid and protein monolayer penetrating (cytolysing) or adsorbing (agglutinating) agents, and we deduce that their surface structures must contain lipoproteins or consist of a lipoid protein mosaic; whereas certain other unicellular animals frequently found associated with Paramecia and, in addition, cilia of *Mytilus* are not affected by protein adsorbants or dispersants but are readily influenced by lipoid penetrating agents, and their coatings in consequence must be chiefly lipoidal in nature.

Examination of the carcinogenic hydrocarbons by the monolayer technique reveals the interesting fact that, whilst they themselves are unreactive, they are readily converted into extremely reactive water-soluble unstable photo-oxidation products. These substances are not only reactive to protein monolayers like the water-soluble dibenzanthracene endosuccinate (see graph) but are also paramecidal, a general parallelism between the biological activity and monolayer reaction being maintained.

Finally, it may be suggested that the concepts of specificity which we draw from the principle that both polar and non-polar interaction participate in molecular adlineation in monolayers, if applicable to biological reactions in general, present us with a set of principles which permit of direct experimental application and theoretical attack.

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[2] Dodds, Lawson and Campbell, NATURE, **142**, 1121 (1938). Dodds, Golberg and Robinson, NATURE, **142**, 34 (1938); **141**, 247 (1938). Dodds and Lawson, NATURE, **139**, 1068 (1937). We are indebted to Prof. Dodds and Dr. Lawson for specimens of these derivatives.

OBITUARIES

Dr. Edward Kidson, O.B.E.

DR. EDWARD KIDSON, director of the Meteorological Office, Wellington, New Zealand, died suddenly on June 12 at the early age of fifty-seven years.

Dr. Kidson belonged to a well-known Nelson and Christchurch family, but was born at Bilston, Staffordshire, on March 12, 1882. He received his school and university education in New Zealand, graduating at the University of New Zealand with first-class honours in physics in 1904. His first post was that of assistant observer at the Magnetic Observatory, Christchurch, which led to his joining the staff of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington in 1908. Before the Great War he was engaged on magnetic surveys in South America, Newfoundland and Australia, and he spent six months as magnetic observer on the magnetic survey ship *Carnegie* belonging to the Carnegie Institution.

During 1915–1919 he was on active service in the Meteorological Section of the Royal Engineers with the Salonika Force. He was mentioned in dispatches and made O.B.E. for his war service. After the War he returned to the Carnegie Institution and was given charge of its Magnetic Observatory at Watheroo, Western Australia. Kidson remained at Watheroo from 1919 until 1921, when he joined the Meteorological Service of the Australian Commonwealth as assistant director.

In 1921 Kidson returned to New Zealand on being appointed director of the Meteorological Office, Wellington. The Meteorological Service of New Zealand when Kidson took charge was in a very unsatisfactory state and the total staff numbered only five. With characteristic energy he set to work to build up a service based on modern scientific lines. Kidson's travels had kept him in touch with meteorological progress in America and Europe; he was a man of science and appreciated the work of the Norwegian school of meteorologists. He visited Bergen in 1931 and 1935 and, aided by one of Dr. Bjerknes's assistants, who stayed a few months in New Zealand on his return from the Antarctic, he introduced the Norwegian ideas into the work of his service and in this way broke new ground in the study of meteorology in the southern hemisphere. He was fortunate in his choice of scientific assistants, and with their aid built up a meteorological service, consisting of forty-five members, which compares favourably from a scientific point of view with the meteorological service of any other country.

Kidson's own scientific work, with the exception of the reports he prepared on terrestrial magnetism while on the staff of the Carnegie Institution, was devoted almost entirely to meteorology. He wrote extensively on the climate of New Zealand, and was interested in the investigation of the upper atmosphere. He published papers on weather forecasting and the theory of tornadoes. He was particularly interested in Antarctic meteorology; his chief published work was a thorough discussion of the meteorological records of Shackleton's first expedition (1907–9) and at the time of his death he was on the point of completing a compilation and discussion of the meteorological data obtained on Mawson's later expeditions.

Kidson's sound scientific knowledge, coupled with a wide and sane outlook on international meteorological problems, was unsurpassed in the southern hemisphere, and his early death just at the time when such qualities are especially required is a real tragedy.

G. C. SIMPSON.

Dr. C. H. Mayo

DR. C. H. MAYO, who died on May 28, was one of the greatest of contemporary American surgeons. During his active career of nearly fifty years, he was associated with his elder brother, Dr. W. J. Mayo, in founding and fostering the Clinic in Rochester, Minnesota, which bears their name. In their lifetime, this has expanded rapidly until now it is a huge centre of medical and scientific effort, an expansion the more remarkable because of the small size of the town and its distance from main roads and railways.

Dr. Mayo's scientific work cannot be considered apart from the development of the Clinic. At an early date the brothers determined to devote the profits of the enterprise to the furtherance of medical education and research, and gradually brought together a team of workers which included clinicians, experts in preclinical subjects and, notably, experts in the related sciences of biochemistry and biophysics. Thus their object has come to be the intensive study of all aspects of disease, as well as its treatment. This type of organization was an admirable background for Dr. Mayo's substantial contributions to the surgery of the thyroid gland. He was one of the earliest to operate for thyrotoxicosis, and did much to eliminate the technical difficulties associated with this procedure. Later he was able to utilize the discovery by his colleagues, H. S. Plummer and Boothby, that the administration of iodine reduced the dangers of operation, and to add and adopt further refinements in pre-operative and post-operative care, and in surgical technique. His work on transplantation of the ureters to the colon in cases of ectopia vesicæ was also outstanding, and in his hands this was a safe and satisfactory operation. He approached the problem as a biologist, and in inducing the rectum to function as a cloaca he displayed great technical ingenuity and a sturdy respect for the conservation of renal function.

Dr. Mayo was essentially a general surgeon, and his nimble mind attacked and solved many diverse

problems of technique. In the operating theatre he combined wise conservatism with amazing resourcefulness, and one of his delights was to introduce and perfect operative details, many of which are in general use. His reputation was international, and this, with his personal charm, made him a welcome figure at surgical meetings the world over. Based as they were on great experience and uncommon clinical acumen, his opinions were listened to with respect, and both abroad and in the Clinic he did much to secure the free interchange of surgical ideas and ideals.

Prof. Edgar Zunz

WE regret to announce the death on June 11 after a short illness of Dr. Edgar Zunz, professor of pharmacodynamics and therapeutics in the University of Brussels and an eminent personality in the Belgian medical world. He was born at Charleroi on November 9, 1874, and received his medical education at Brussels where he qualified with distinction in July 1897. Having won a travelling scholarship, he spent some time at Heidelberg in studying organic chemistry in Gattermann's laboratory, and later at Strassburg in Hofmeister's laboratory of biochemistry and at Bern under Kronecker, the physiologist. On his return to Brussels in 1900 he was appointed assistant to Prof. Victor Jacques in the laboratory of pharmacodynamics and therapeutics. In the following year he presented a thesis to the University of Brussels on the digestion of albuminoid substances, which gained him the degree of doctor in physiological science. In 1906 he was appointed an *agrégé* in the Brussels medical faculty, and gave a course of practical demonstrations in medical chemistry. In 1909 he became lecturer to postgraduates in toxicology and in 1913 instructed students in the elements of pharmacography. During the War he did valuable work as director of the medical department including the care of the gassed at the Ocean Ambulance at La Panne. In 1919 he was appointed professor of pharmacodynamics and therapeutics in the Brussels faculty of medicine and held this post until his death.

Zunz was a remarkably fertile writer. His two chief works were his treatises on general and special pharmacodynamics published in 1930 and 1932 respectively. He also collaborated with Prof. Terroine in a work on basal metabolism (1925), and contributed articles on coagulation of the blood to Roger and Binet's text-book of physiology and on the regulation of the composition of the blood to the fourth volume of the "Encyclopédie Française". He further contributed many papers to Belgian and foreign journals on the digestion of proteins, the properties of proteoses and peptones, coagulation of the blood, secretion of adrenalin and insulin, action of the alkaloids of opium, the process of digestion, phenomena of adsorption and surface tension, and the effects of poison gases. He took an active part in the campaign against alcoholism and was president of the International Congress Against Alcoholism held at Antwerp in 1928 as well as president of the scientific committee of the World Union Against Alcoholism.

Zunz was the recipient of many honours. In 1919 he was elected a member of the Belgian Royal Academy of Medicine, of which he became president in 1934, and in the following year was president of the annual congress known as the Journées Médicales de Bruxelles. He was also an Officer of the Order of Leopold, Commander of the Order of the Crown, Officer of the Legion of Honour, honorary doctor of the University of Montpellier and corresponding member of the Royal Academy of Medicine of Rome.

J. D. R.

Prof. Rudolf Fick

PROF. FICK, who died on May 23 at the age of seventy-three years, retired from the chair of anatomy in the University of Berlin in 1935. He brought down to the rising generation of German anatomists the great traditions of Gegenbaur and of Koelliker. Indeed Prof. Fick's first appointment was in Koelliker's department at Würzburg. His earliest research work was on the ripening of the cells of reproduction, which led to his becoming assistant to Wilhelm His in Leipzig. There the nature of his inquiries took a new direction; he applied to the study of the human body a more complete understanding of mechanics than had been done previously. The results of his studies are embodied in his "Handbuch der Anatomie und Mechanik der Gelenke" (1904–1911; 3 vols.). His fellow anatomists admired his researches more than they studied them. In all he did there are to be seen care and accuracy. This is particularly true of his pioneer research into the anatomy of the orang—carried out on adult animals which died in the Zoological Gardens of Leipzig towards the end of the nineteenth century.

Prof. Fick was born in Zurich, the son of the distinguished physiologist. Although born in Switzerland he was intensely German in feeling and in aspiration. From an assistantship in Leipzig he was appointed to the German University in Prague in 1905. Four years later he was invited to Innsbruck. In 1917 he was called to Berlin to fill the highest post in anatomy in Germany—a prize awarded perhaps more because of his outstanding merits as a man than of the importance of his researches in anatomy. His chief aim in life was to teach his students; he preferred to spend his energies and time in the preparation of anatomical specimens to illustrate his lectures rather than on researches for the advancement of anatomy.

WE regret to announce the following deaths:

Mr. Henry Havelock Ellis, a pioneer in the psychology of sex, on July 8, aged eighty years.

Prof. R. I. Meyer, editor of the latest edition of "Gmelin's Handbuch der Anorganischen Chemie", known for his work on the rare earths, on June 18, aged seventy-four years.

Prof. G. E. Nichols, professor of botany and director of the Botanical Gardens at Yale University, on June 20, aged fifty-seven years.

NEWS AND VIEWS

Prof. F. C. Minett

FRANCIS COLIN MINETT, who has just been appointed director of the Imperial Veterinary Research Institute of the Government of India, was educated at King Edward's School, Bath, from 1899 until 1907, and in the latter year entered the Royal Veterinary College. Two years after obtaining the diploma of membership of the College, he was awarded a Ministry of Agriculture research scholarship and studied at the Pasteur Institute in Paris and at the Veterinary School in Alfort. On the outbreak of the Great War, he joined the R.A.V.C. and proceeded to France with the Expeditionary Force. In the following year he returned to Aldershot, where he was engaged in research and in the preparation of mallein for the diagnosis of glanders—at that time a problem of urgent military importance. From 1921 until 1924 he served in Egypt, and in the latter year resigned his commission upon receiving an appointment under the Foot-and-Mouth Disease Committee. He was awarded the D.Sc. in veterinary science of the University of London in 1927, and in the same year, upon the retirement of Sir John McFadyean, was appointed director of the Research Institute in Animal Pathology at the Royal Veterinary College, and, in 1933, when the posts became amalgamated, he was appointed professor of pathology and director of the Research Institute.

DURING the past twelve years, Prof. Minett has contributed generously to the study of many problems associated more particularly with diseases of economic importance among farm animals. In this connexion, special reference should be made to his work upon bovine mastitis, Johne's disease and contagious abortion of cattle, as a result of which, measures for the more effective control of these diseases have been established. Important as his researches have been, it is safe to say that one of his chief claims to recognition lies in his ability as a teacher. Indirectly, as well as by direct contact with his students and junior members of his research staff, he has advanced the study of veterinary pathology to a marked degree.

Bicentenary of Du Fay (1698–1739)

ON July 16, 1739, the death occurred of the French man of science, Charles-François de Cisternay du Fay, who though he wrote memoirs on many subjects and was superintendent of the Jardin des Plantes, is remembered to-day for his electrical experiments and observations. Born in Paris on September 14, 1698, he was an officer in the French Guards, and for a time followed a military career. Ill-health, however, led to his resignation and he then turned to literary and scientific pursuits. He was admitted to the Academy of Sciences in 1733 and contributed papers on geometry, astronomy, mechanics, chemistry and botany. He was especially interested in the electrical experiments of Stephen Gray, and suspending himself by silk cords, as described by Gray, he observed that when he was electrified, and another person came near, there issued from his body pricking shoots, making a crackling noise. The Abbé Nollet (1700–70) was associated with these experiments, which he afterwards extended. Du Fay also discovered two kinds of electricity which he named the *vitreous* and *resinous*, and he made attempts to formulate a theory of electric phenomena. A man of great industry, as superintendent of the Jardin des Plantes he did much to rescue that institution from neglect, and it was through him that Buffon became his successor.

Julius Cohnheim (1839–1884)

PROF. JULIUS COHNHEIM, the eminent experimental pathologist, was born on July 20, 1839, at Demmin in Pomerania. He studied medicine at the universities of Würzburg, Marburg, Greifswald and Berlin, where he qualified in 1861 with a thesis on suppuration in serous membranes. After acting as an assistant to Virchow in Berlin and serving as an army surgeon in the war with Austria, he was appointed professor of morbid anatomy at Kiel, where he remained until 1872. He was then transferred in a similar capacity to Breslau and finally occupied the corresponding chair at Leipzig in 1878, where he stayed until his death six years later. Cohnheim was a highly skilled technician, and made several valuable contributions to microscopical science, among which may be mentioned his methods for demonstrating the nerve endings in the cornea, the structure of striated muscle and the phenomena of inflammation. His successful inoculation in 1868 of tuberculosis in the anterior chamber of a rabbit's eye, thus proving the disease to be infectious, is an important landmark in the history of tuberculosis. His principal literary work is represented by his lectures on general pathology published in 1877–80 and translated in 1888–90 in the New Sydenham Society's publications, in which he dealt with the pathology of the circulation, nutrition, digestion, respiration, genito-urinary organs and animal heat. He also published several valuable articles on malignant growths, trichinosis and the bone marrow in anæmia. His stimulating lectures attracted a large number of students from all parts of Germany, and he had many men who later became eminent among his audience, including Heidenhain, Litten, Welch and Neisser at Breslau and Roy and Councilman at Leipzig. He died at the early age of forty-five years on August 15, 1884, from the effects of gout.

New Long-Distance Air Liner

PRELIMINARY details of a new civil transport aeroplane, the Fairey C.I., have just been made public. It is a low-wing monoplane fitted with four Bristol 'Perseus' sleeve-valve engines of 1000 h.p. each. The body is of a circular section monocoque construction, arranged to carry thirty passengers.

The undercarriage is of tricycle form so placed that the machine can land and stand with the cabin horizontal, which will increase the comfort of the passengers and facilitate loading up when on the ground. The wheels are retractable during flight. The cabin is air-tight, and conditioned air at ground-level density is maintained when flying at altitudes. The machine is fitted with an automatic pilot, relieving the pilot of most of his physical work, and making him more analogous to the captain of a ship. The whole of the mechanical detail is controlled from the flight engineer's cabin, who has actually sixty-four dials on his instrument board, dealing with matters varying from engine and flying performance down to the condition of the air in the cabin. A new feature of this machine is an auxiliary wing that can be retracted when not required. It is shaped like the more familiar trailing edge flap, and thus can be used as an air brake for reducing landing speeds as well as providing the extra surface for increasing the flying speed range. This additional surface allows for a wing loading of 25 lb. per square foot for taking off and landing, which is increased to 32 lb. per square foot while flying with it retracted. The estimated speeds of the machine are 275 m.p.h. maximum, and 220 m.p.h. cruising, and its air endurance with the full load of passengers will enable it to operate non-stop to any European capital. With a decreased pay load it will be capable of fast non-stop services on the Empire routes.

Neanderthal Man in Italy

IN more respects than one, the discovery of a skull of Neanderthal man in the Guttari cave at Monte Felice Circeo, about sixty miles south of Rome, is of unique significance for the study of the chronology and distribution of Mousterian man in Europe of the palæolithic period. Owing to conditions affecting the use of the cave by man, it is possible to fix the date of occupation within tolerably accurate limits, while the sealing of the cave in Mousterian times which brought that occupation to a close, has not only preserved the evidence of Neanderthal man and his domestic economy intact but also saved it from the superposition of the debris of subsequent intrusions—conditions unique in caves of Mousterian occupation. The skull, now the third of the type known from Italy, was found on February 25, 1939, by Dr. A. C. Blanc of the University of Pisa, who with the Abbé Breuil, discovered the second of the Italian Neanderthal skulls. Dr. Blanc had already examined thirty-one caves at Monte Circeo and found in them evidence of both the Mousterian and Aurignacian cultures, but the present find was made in a cave which had been discovered on the previous day only by its owner, S. A. Guttari.

THE skull lay on the floor of an inner chamber of the cave among stones which appear to have been laid in a circle around it, while underneath it were bones of Equus, Bos, Cervus and Sus, some of which had been intentionally flaked. The floor of the whole cave was covered with fossilized mammalian bones, antlers and skulls, including, in addition to those mentioned, hyæna and others, while elephant bones were found in a pool. All belonged to a warm climatic phase. This Neanderthal skull is the most perfect yet known, and in size approaches that of La Chapelle aux Saints. A fracture of the right temporal region points to a violent death; and the base of the skull has been opened extensively and the greater portion of the occipital foramen destroyed. The date of occupation is fixed by relation to the oscillation of sea-level at somewhere between 130,000 and 70,000 years ago; and Sir Arthur Keith, who contributed a prefatory note to an account, with illustrations, of Dr. Blanc's discovery in the *Illustrated London News* of July 5, regards these relics of Neanderthal man as contemporary with the lowest level of the Grotte des Enfants, Mentone.

Recent Additions to the British Museum (Bloomsbury)

SOME striking examples of West African art were among the more important of the recent additions to the ethnographical collections of the British Museum, which were reported at the meeting of the Trustees on July 8. Of these one was a gift of the National Art Collections Fund—a cast bronze head which was excavated at Ife, the religious centre of the Yoruba people, and is said to represent Olokun, the Yoruba deity of the sea. Discovered in 1938, it is in good condition, and shows traces of red paint on the head-dress. Probably it belongs to the fifteenth or sixteenth century, though the date is uncertain. Its modelling is of a quality unique among the artistic productions of negro Africa, and bears comparison with the finer sculptures of civilized art. The second example of African art is a carved ivory tusk from Benin, which bears figures of fish and animals, symbolizing the king in his supernatural aspects. There is a receptacle for magical 'medicine' at the larger end. No similar example is known. The gift to the Department of Manuscripts of the diaries of Robert Needham Cust, an Indian civil servant well known as an orientalist among scholars of the nineteenth century, will be welcomed by all who are interested in the history of Indian and oriental studies. The diaries were presented by his son, Mr. R. H. H. Cust.

Utilization of Coal

THE British Coal Utilization Research Association held its first annual meeting in London on June 28, when Sir Evan Williams, the president, gave an account of its first year's work, which has been largely concerned with the erection and organization of its research station in Fulham. It has been a subject of reproach that the coal industry has been largely indifferent to promoting efficiency in the utilization of coal. They now foresee, the president said, that the future will call for fuels of accurately controlled characteristics; the development of these is being investigated. The programme of research includes work on pulverized fuel firing which, it is believed, will play an increasingly important part in industry, and also on combustion in the fuel bed.

The study of producer gas is to receive greater attention in view of its present importance in heavy industry and its potential application to mechanical transport. Great store is laid by the coal industry on the open coal fire, and efforts are being made to minimize its admitted defects—smoke and labour. It is recognized that coal-burning appliances have suffered in comparison with gas and electrical appliances owing to the neglect of scientific principles in design, and it is hoped to raise the standards of performance and eliminate inferior and ineffective appliances. Efforts are being made to advance the use of coal for cooking. A solid fuel cooker has been designed for use on railways. Some of these have been installed on trains, including the *Coronation Scot*. It is believed that gravity feed firing will play a considerable influence on hotel and institution cookery in the future.

Collective and Economic Security

POLITICAL and Economical Planning (P E P) has issued two broadsheets dealing with the economics of collective security and instruments of economic security. In the former, relations between economic policy and a fresh effort to realize collective security are discussed and the necessity of military support for economic collaboration is emphasized, and the importance of ascertaining how far geography and the balance of strategic forces would permit military assistance if needed before inviting smaller countries into a system of collective economic security. The maintenance of peace through collective political and economic security involves the application of principles similar to those which would be appropriate in time of war. The measures of self-defence now required of a system of collective security may be classified as those required for preserving and promoting the free exchange of goods and services between members of the system; steps needed to ensure that the advantages of participation in economic relations on those terms should no longer be available to nations which do not subscribe to the conceptions inherent in the free exchange system and which now only participate in that system to destroy; and measures for extending assistance to neutral countries to enable them with safety to enter the orbit of the free system. Civilization's resources, it is urged, should be used to maintain civilization, and the main economic implications of a policy of collective security are discussed in some detail, including the question of reciprocal aid, the utilization of limited resources, the difficulty of overvalued currencies, the possibility of organizing markets and Nazi political and economic exploitation. If civilization is to be preserved it cannot be in isolation. Its basis is international, and there is no alternative to collective measures.

THE second broadsheet, emphasizing the need for industrial reorganization, classifies the possible measures under four heads, according to their connexion with Government commercial policy, with the improvement of trading methods, with the finance of international trade and with export and import subsidies. The absence of any coherent British trade policy is criticized. The United Kingdom has a strong bargaining weapon for securing increased reciprocity in commercial relations with individual States in view of the importance to them of British import purchases, and it is suggested that 'most favoured nation' treatment might be withheld from countries which resort to unfair trade practices. Much could still be done to improve the mechanism of economic co-operation and the importance of control schemes and cartels being operated in the public interest and particularly in the interests of economics is stressed. The questions of export credits, import subsidy, and of selecting the appropriate measure for different purposes are then discussed, the final emphasis being laid on the need for more moral courage to form the nucleus of a system of collective economic security in which the benefits of free exchange would be limited to the free exchange group.

Employment in 1938

THE report of the Ministry of Labour for the year 1938 shows that on the average for the year the numbers in employment were about 120,000 less than in 1937 although higher than in any previous year except 1937, and more than 20 per cent higher than in 1924, when the series of comparable statistics was begun (Cmd. 6016. London: H.M. Stationery Office, 1939. 2*s*. net). The seasonal fluctuations were less than usual, the maximum variation in the rate of unemployment among insured persons in the general scheme being only 0·5 per cent as against variations of from 2 to 5 per cent in previous years. Seasonal improvement in the first half of the year, however, was much less marked than usual in the building and contracting industries, brick manufacture and the distributive trades, and was almost entirely offset by a decline in metal and metal goods manufacture, engineering, the textile industries, especially in the cotton industry, and the normal slackening in coal mining. In the second half of the year the seasonal decline in building and public works contracting, transport, distribution and the hotel and boarding-house service was counterbalanced by improvements in the textile industries, metal goods manufacture, and the vehicle and mining industries. The effects of the recession of 1937–38 were spread very unevenly over different areas of the country, being most marked in the north-western area, in which employment declined by 7·5 per cent, mainly through contraction in the cotton industry. Wales suffered severely with a fall of 5·4 per cent, mainly in the iron and steel and tin-plate industries. In the Midlands there was a fall of 3·4 per cent and in the south-eastern division no change.

REFERENCE is made in the report to the policy of the Ministry in regard to the admission of foreign workers. Of the 22,347 permits granted during the year, 61·7 per cent were for employment in private domestic service. The figures do not include persons

admitted to the United Kingdom by the Home Office as refugees and who have been allowed to enter into employment as domestic servants in private households. The Government policy of locating new factories and other establishments required in connexion with the defence programme in areas of heavy unemployment, so far as strategic and other practical considerations allow, has led during the year to the setting up of new establishments employing many thousands of workers in the Special Areas and in other areas of heavy unemployment. With regard to juvenile employment, the report points out that the estimated number of juveniles aged 14–17 available for employment was about 159,000 less than at the end of 1937. The numbers aged 14 entering the industrial field have been decreasing since 1934, and by 1934 the decline in the birth-rate after 1920 had influenced the numbers in the whole 14–17 group. Although prospects of employment for juveniles remained fairly good in most parts of Great Britain, they were less bright than in 1937.

British Trust for Ornithology

THE fifth annual report of the British Trust for Ornithology reveals the remarkable progress made in the co-ordination of field studies in Britain in recent years, and much space is given to the results of these field investigations. They include the lapwing habitat inquiry, and that of the distribution of the corncrake, which is to be continued this year. In 1938, 1200 completed returns were received referring to the corncrake and noting its decreasing numbers, most marked in Ireland and least in Scotland; efforts are being made to get information from the Continent, where the species is also decreasing. The survey of black-headed gull colonies had 150 observers, and shows that few coastal counties have been colonized in the past twenty-five years, but there has been a marked inland spread. The sample census of heronries shows an increase of breeding stock in many places, and three heronries in England now have between 120 and 150 nests. The bridled guillemot inquiry shows that few of this variety are in the English and Welsh colonies, but the percentage increases from about lat. 56° N. The woodcock inquiry showed by ringing that occasional British woodcock accompany the winter migrants when they return to their native breeding haunts. The woodland bird inquiry gave special attention to the British sub-species of birds, which can be divided into four groups showing thirty-seven distinctive races of bird entirely confined to Britain. A new inquiry on the redshank is planned for 1939–40 and a hatching and fledging inquiry will extend nationally the work started at Whipsnade Bird Sanctuary.

Tuberculin Tests in Cattle

BOVINE tuberculosis is one of the most serious scourges that afflicts cattle in Great Britain, causing an annual loss which has been estimated to amount to £2,000,000 annually. The disease in dairy herds is also responsible for much human tuberculosis, particularly in children. The eradication of tuberculosis from herds is now receiving serious attention. The detection of tuberculous animals by means of the tuberculin test is employed in all schemes for the eradication of bovine tuberculosis, but in recent years modifications in methods of preparation of tuberculin and in its application have been introduced. The need for detailed research into various problems associated with the tuberculin test was recognized by the Joint Tuberculosis Committee of the Medical Research and Agricultural Research Councils, and work on the subject was undertaken at the Institute of Animal Pathology, Cambridge, by Prof. J. B. Buxton and Mr. R. E. Glover, and the results of their investigations are published in a report issued by the Agricultural Research Council ("Tuberculin Tests in Cattle". H.M. Stationery Office. 1*s.* 6*d.* net). After dealing with the different methods of applying the tuberculin test, sections are devoted to the value of several types of tuberculin, sensitization and desensitization of tuberculous and non-tuberculous cattle to tuberculin, and the possibility of 'doping' against the various tests. Experiments are also described in which attempts were made to sensitize normal cattle to tuberculin itself, and finally, the significance of reactions, resulting from infections with organisms closely allied to the bovine tubercle bacillus, is discussed.

University of London: Principal's Report

IN recent years a corporate university spirit has made itself increasingly felt in London. Its growth has, naturally, been stimulated by the erection of the imposing block of central buildings in Bloomsbury and the grouping there in association with them of several important schools and institutes. It will receive a further notable impulse from the opening of the new Students' Union. The Union has already proved its value as a centre of student life, and Lord Nuffield's gift last year of £50,000, added to a grant of £25,000 from the National Fitness Council and one of £35,000 from the University Grants Committee, has enabled the Court to proceed to the construction and equipment on a generous scale of a permanent home for it. Among other interesting items of the Principal's report may be mentioned: a closer association with external students through a new system of communicating detailed examination results to all Intermediate Examination candidates and to the institutions responsible for their training; a new Certificate in Natural History for prospective teachers of nature study in primary schools; and the establishment of an editorial board under the chairmanship of Sir Bernard Pares, who is retiring from the directorship of the School of Slavonic and East European Studies, to be responsible for the publication of the *Slavonic and East European Review*.

New Entomological Journals

THE Entomological Society of Southern Africa was founded in 1937 and the first volume of its *Journal*, dated March 30, 1939, has come to hand. It contains seven papers, covering a very wide range of subjects, including taxonomic studies on Diptera

(B. de Meillon, H. K. Munro), the biology of a nest-living Sarcophagid (A. Cuthbertson), studies of new Thysanoptera (C. Jacot-Guillarmod), descriptions of South African moths (A. J. T. Janse), the control of temperature and humidity in small cabinets (M. N. S. Immelman) and finally on the general classification of insects (J. Omer-Cooper). The journal is excellently printed and illustrated, and the first volume, including also index, obituary notices and list of members of the Society, extends to 163 pages. It is obtainable from the Honorary Secretary of the Society, P.O. Box 103, Pretoria, South Africa, and from N. V. Swets and Zeitlinger, Keizersgracht 471, Amsterdam, Holland. The price of the volume is £1 2*s*. 6*d*.

IT is announced in the *Bee World* that an All-India Bee-Keepers' Association has been founded with an official organ, the *Indian Bee Journal*, the first issue of which appeared in January 1939. Owing to various causes, modern apiculture has an uphill journey in order to take its appropriate place in the scheme of Indian agriculture. The difficulties are being surmounted and the inauguration of the above Association and its *Journal* is likely to become an important factor in future progress. The address of the Association is Jeolikote, Naini Tal, U.P., India, and the annual subscription to the *Journal* is 3 rupees for one year, and proportionately less for two or more years.

Earthquakes during April 1939

ACCORDING to the Central Seismological Bureau at Strasbourg there were 152 earthquakes each recorded at more than one observatory or experienced by people during the month of April. This was 52 more than during March (NATURE, June 10, p. 988). The greatest number recorded on any one day was on April 6, when 14 occurred, and the least number recorded on any one day was 2 on each of April 8, 9, 28 and 30. The most important shocks during the month were probably those of April 1 (strength VIII) felt near Mostaganem in Algeria, April 18 at 6.23 G.C.T. in Chile (epicentre 27° S., 70° W. approx.), and that of April 30 felt at Guadalcanar and several other places in the Solomon Islands. The next most intense were the earthquakes of April 5 with epicentre near 20° S., 168° W., in the New Hebrides, April 21 at 4.29 G.C.T. (epicentre near Yeso), and April 23 at 16.23 G.C.T. (epicentre in the Atlantic near 1° S., 17° W.). Apart from these individual shocks there appears to have been a good deal of moderately intense seismological activity in Italy as earthquake shocks have been experienced at Livorno on more than one occasion, in the Frioul district and near Mont Amiata.

British Standards for A.R.P. Requirements

THE Home Office Air Raid Precautions Department has arranged with the British Standards Institution to prepare and issued on its behalf a special A.R.P. series of British standards for air raid precautions purposes. The preparation of these standards will be under the control of a special advisory committee, and in accordance with the usual practice of the British Standards Institution will be carried out in the closest co-operation with Government departments and the industry concerned. All communications relating to this work should be addressed to the British Standards Institution, 28 Victoria Street, Westminster, S.W.1.

Research in Pathology at Leeds

THE report for the years 1937 and 1938 of the Department of Pathology and Bacteriology of the University of Leeds, by Profs. Matthew Stewart and J. W. McLeod, has recently been issued. A summary of the routine examinations carried out is first given, followed by abstracts of the research work that has been done. This includes investigations on cases of silicosis and asbestosis, studies on the morbid anatomy and histology of chronic arthritis and its treatment with gold salts, and investigations on the morbid histology of diphtheria caused by the three types of the diphtheria bacillus. A report on cancer research is also contributed by Prof. R. D. Passey.

Conference on Engineering Education and Training

A CONFERENCE on Engineering Education and Training will be held at the Institution of Civil Engineers during February 6–8, 1940. Sir Clement Hindley, president-elect of the Institution, will preside over the Conference, which is being organized by a general committee representative of engineering institutions, universities, technical schools and colleges, engineering consultants, industrial organizations, Government departments and other interests. It is proposed to publish a number of papers, to be circulated in advance, which will form the basis of discussion at the technical sessions of the Conference. Inquiries should be addressed to the Secretary, Institution of Civil Engineers, Great George Street, London, S.W.1.

Two Large Sunspots

Two large groups of sunspots were conspicuous on the sun's disk during the past week. The larger of these groups, in latitude 4° south, appeared over the sun's east limb on July 3 and became a complex group with an area exceeding 1700 millionths of the sun's hemisphere. Its time of central meridian passage was July 9·3 U.T. The other group arose from a pair of tiny spots seen on July 4 in north latitude 6°. Shortly after its central meridian passage on July 8·2, it had reached an area of 1000 millionths.

British Empire Cancer Campaign

AT the seventy-first quarterly meeting of the Grand Council of the British Empire Cancer Campaign held on July 10, the following grants were approved: £400 to Mount Vernon Hospital for the employment of Prof. F. Weigert for research on a special biochemical problem; £495 to the Strangeways Research Laboratory, Cambridge, for the

salary of its physicist, Dr. D. E. Lea, and £400 to Sir Robert Muir and Dr. P. R. Peacock for research to be carried out at the Glasgow Royal Cancer Hospital by Dr. Stephan Beck. This brings the total grants made to date by the Campaign for cancer research for the year 1939 to more than £49,000. The formation of a University of Cambridge Research Centre of the British Empire Cancer Campaign was approved. The initial Committee to supervise this Centre will consist of the Vice-Chancellor, Prof. H. R. Dean, Prof. J. A. Ryle, Sir Frederick Gowland Hopkins and Dr. Honor Fell, augmented later by other scientific workers at Cambridge. In future this Centre will co-ordinate all the cancer research being carried out at Cambridge and will itself initiate and direct research in the same way as the recently formed University of Oxford Research Centre of the Campaign. The Grand Council acceded to the request for affiliation from the Cancer Research Fund Committee (1934) of Northern Ireland, which now provides a link between the work of the Campaign and the cancer research being carried out at the University of Belfast and in Ulster generally. The following were elected members of Grand Council: Prof. J. A. Crowther (professor of physics in the University of Reading), Dr. H. T. Flint (director of physics at Westminster Hospital), Dr. R. W. Scarff (honorary secretary of the Scientific Committees of the Campaign) and Mr. D. G. Walker to represent the British Dental Association.

The Colonial Service: Recent Appointments

THE following appointments and promotions in the Colonial Service have recently been made: W. T. S. Brown, assistant conservator of forests, senior assistant conservator of forests, Gold Coast; F. S. Danks, assistant conservator of forests, Cyprus, assistant conservator of Forests, British Guiana; H. W. Moor, senior assistant conservator of forests, divisional conservator of forests, Gold Coast; G. M. Tolmie, assistant conservator of forests, senior assistant conservator of forests, Gold Coast; B. E. Frayling, chief inspector of mines, Tanganyika Territory, chief inspector of mines, Nigeria; J. K. Cox, inspector of plants and produce, agricultural superintendent, Gold Coast.

Announcements

DR. EMIL ABDERHALDEN, professor of physiology at Halle, and Dr. Max Planck, professor of theoretical physics at Berlin, have been elected honorary members of the Société Philomathique of Paris.

LORD HORDER has been elected president of the National Society for the Prevention of Venereal Diseases in succession to Sir Basil Peto, a founder-member and president since 1926.

AN exhibition is being arranged at the Science Museum, South Kensington, in conjunction with the Royal Photographic Society and the photographic industry to illustrate the history of photography from the time of its inception in 1839 down to the present day. The exhibition is being opened by the Marquess of Salisbury on July 20, and will be open to the public on July 22 for five weeks.

A SYMPOSIUM on "Growth and Development" to be held at North Truro, Massachusetts, during August 7–11 has been organized by the journal *Growth*. Grants towards the cost of the conference have been received from the Macy and Rockefeller Foundations. The topics for discussion, with their principal speakers, are: cell division and differentiation (Prof. W. H. Lewis, Prof. P. W. Gregory); genes and development (Prof. Curt Stern, Dr. C. H. Waddington); chemical factors (to be announced) (Dr. J. Needham); regeneration, organization (O. E. Schotte, Prof. E. W. Sinnott); concept of organism (Dr. J. H. Woodger). Further information can be obtained from Dr. Philip White, Rockefeller Institute for Medical Research, Princeton, New Jersey.

THE People's League of Health has organized a scheme of clinical research to determine the influence of diet on expectant and nursing mothers in relation to maternal mortality and morbidity. Systematic observation and records are being collected at the ten London hospitals which are co-operating with the League in this research.

ACCORDING to the Central Dutch Office of Statistics, the average duration of life in men is at present 65·1 years and in women 66·4 years as compared with 38·4 and 40·7 during the period 1870–1879. The infant mortality, which was then as high as 22 per cent in males and 20 per cent in females, is to-day only 5 and 4 per cent respectively. During 1870–1879 only 7·6 per cent of Dutchmen reached the age of eighty years, whereas in 1931–1935 no less than 25 per cent reached that age. Holland has consequently the lowest mortality in Europe.

THE Council of the Royal Society of Arts offers a prize of £25 under the Thomas Gray Memorial Trust for an invention, publication, diagram, etc., which is considered to be an advancement in the science or practice of navigation, proposed or invented in the period January 1, 1934 to December 31, 1939. Under the same trust, a prize of £25 for an essay on "The Carriage of Dangerous Goods by Sea" is offered. Further information can be obtained from the Secretary, Royal Society of Arts, John Street, Adelphi, London, W.C.2.

A RESEARCH scholarship of the value of £250 per annum and tenable for two years has been founded by the Wrought Light Alloys Development Association to encourage and facilitate research in the application of light alloys to ship construction. The scholarship will be administered by a Committee of the Institution of Naval Architects and it is hoped to make the first award in September 1939. Further information can be obtained from the Secretary, Institution of Naval Architects, 10 Upper Belgrave Street, London, S.W.1.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 119.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Glutamic Acid of Tumour Proteins

IN analysing tumour proteins, we[1] have isolated without exception partially racemized glutamic acid. However, Chibnall and co-workers[2] recently reported the isolation of optically pure *l*(+)-glutamic acid in four cases. These authors did not use the same method which we employed, but a different procedure which is excellent for the rapid and efficient isolation of natural glutamic acid from standard proteins.

Prof. Chibnall kindly sent us a copy of his preliminary note so that we could immediately carry out corresponding experiments.

The essential difference in the method of the British authors lies in a preliminary purification of the dicarboxylic amino-acids by precipitating them twice as the calcium salts[3] from 90 per cent alcohol. We have investigated the solubility of the calcium salts and found that the calcium-*d*,*l*-glutaminate is at least ten times as soluble as the calcium salt of the *l*-glutamic acid in 90 per cent alcohol. Although the pure racemic salt is relatively insoluble, the above-mentioned difference can become very important through the tremendous influence of contaminating material in crude extracts, which is well known to all those who have isolated active principles from natural sources.

In our laboratory in recent months, Mr. A. M. Akkerman has investigated the 'ternary' system of *d*- and *l*-glutamic acid hydrochlorides in 20 per cent hydrochloric acid at 0° C. It was found that the *d*,*l*-hydrochloride is not a racemic compound but a racemic mixture (conglomerate), the solubility of which is exactly twice as great as that of the hydrochloride of *l*(+)-glutamic acid. Since we precipitate the crude glutamic acid by saturating the aqueous solution with hydrochloric acid at 0° C., we have also studied the solubilities in this concentration and found that, although both forms are less soluble, they showed quite the same difference in solubility.

In order to test the effects of these solubility differences upon the isolation, we have fractionated a mixture containing 75·5 per cent of pure *l*- and 24·5 per cent of pure *d*-glutamic acid according to the method of the British authors. We obtained 66 per cent of the *l*-glutamic acid originally present in the mixture in pure state ($[\alpha]_D = +31{\cdot}4°$).

The influence of accompanying substances is shown in the following experiment in which we used the hydrolysate from dried calf's embryo from which we had previously been able to isolate optically pure *l*-glutamic acid by our method. 600 mgm. of *d*,*l*-glutamic acid were added to the hydrolysate from 20 gm. of embryo tissue and the mixture fractionated according to the method of Chibnall *et al.* We obtained 1·16 gm. of pure *l*-glutamic acid hydrochloride ($[\alpha]_D = +31{\cdot}2°$). In a second experiment 700 mgm. of *d*,*l*-glutamic acid were added to 7·8 gm. of an alcohol precipitate which was prepared from the same embryo tissue in a previously described manner[1]. The fractionation, when done according to the method of the British authors, yielded 506 mgm. of pure *l*-glutamic acid hydrochloride ($[\alpha]_D = +31{\cdot}4°$).

Since the criticism might be raised that the depressions of optical rotation in our preparations of glutamic acid from tumours could be caused by analytically undetectable impurities having opposite rotation, we have attempted the isolation of the *d*(−)-glutamic acid. A resolution of the partially racemic glutamic acid by E. Fischer's[4] procedure was not practicable since benzoylation itself produces a partial racemization. We have therefore treated a partially racemic glutamic acid from Brown-Pearce tumours with fermenting yeast according to the method of F. Ehrlich[5] and were indeed able to isolate pure *d*(−)-glutamic acid ($[\alpha]_D = -31{\cdot}2°$).

In conclusion, it can be said that the method as it is employed by Chibnall *et al.*, in spite of very good yields obtained in the isolation of *natural* glutamic acid, appears not to be applicable for detecting the *partial racemization* of glutamic acid. In employing the method which we used, we recommend the inoculation with crystals of both enantiomorphs after saturation with hydrochloric acid, and further the recrystallization with the least possible loss of material. Details of our experiments will appear in the *Zeitschrift für physiologische Chemie*.

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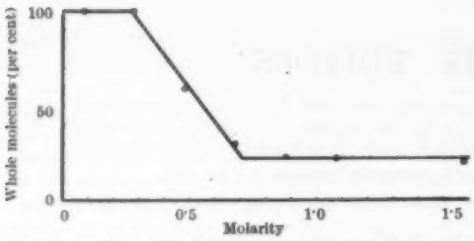
Dissociation of the Hæmocyanin Molecule

SEVERAL proteins are dissociated by a change of the hydrogen ion concentration, by adding amino compounds or salts to the solution [1, 2, 3, 4] and by exposure to various kinds of radiation[5].

The hæmocyanin molecule of *Helix pomatia* (molecular weight 6,700,000) may, upon a change of *p*H, dissociate into halves, eighths and sixteenths[6]. The reaction is reversible: the dissociation fragments recombine, if we bring the solution back to the original *p*H [6]. Certain amino compounds may also cause dissociation[1]:

By means of the ultracentrifuge[1,2] we have investigated the influence of different types of salts and of a few non-electrolytes in acetate (*p*H 5·2) and in phosphate (*p*H 6·0) buffers of molarity 0·08. Well-defined sub-multiples ($\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{16}$ of the original molecule) are obtained. The dissociation effect increases with the valence of the ions. The 1–1 valent sodium and ammonium chlorides both have the same effect: no dissociation occurs in 0·2 molar solutions, while in 1·0 molar 78 per cent of the hæmocyanin is dissociated into half-molecules. Nearly



the same effect is obtained for the 1–2 and 2–1 valent sodium sulphate and calcium chloride in 0·2 molar solutions (32 and 27 per cent, respectively), but the dissociation is different in 1·0 molar solutions, where sodium sulphate gives only half-molecules and calcium chloride eighths and sixteenths.

The dissociation effect of sodium chloride has been studied for a series of concentrations in acetate (*p*H 5·2) and in phosphate (*p*H 6·0) buffers of molarity 0·08, but in neither case were smaller components than half molecules obtained. In Fig. 1 the amount of whole molecules is plotted against the molarity of the electrolytes including acetate buffers. The dissociation reaction starts at the molarity 0·3 and ceases at 0·7, corresponding to a concentration of 22 per cent of whole molecules, after which concentration no more dissociation occurs. The same limiting value (22 per cent) is obtained with phosphate buffers of *p*H 6·0. When we use sodium chloride as dissociation agent, it is of interest to note that the reaction stops before all the whole molecules are dissociated (see graph). In solutions of molarity below 0·3 we have always got whole molecules.

The dissociation effect is smaller for non-electrolytes. The solutions investigated had a molarity of 1·0 in non-electrolytes, 0·2 in sodium chloride and 0·08 in phosphate buffer (*p*H 6·0). Glucose dissociated 64 per cent of hæmocyanin into half molecules, glycerine only 32 per cent. Urea (very often used as a dissociation agent for proteins) causes a dissociation of 58 per cent which is of the same order of magnitude as that for glucose ; in the case of urea, however, 25 per cent of the dissociation fragments are non-uniform low-molecular compounds.

Reversibility has been observed in all cases where the dissociation had given only half molecules. The reaction is not completely reversible when the fragments obtained by the dissociation are smaller than half molecules.

It is shown from this and earlier investigations that dissociation of the hæmocyanin molecule is produced by a great variety of substances, and it follows that the effect is a general rather than a specific reaction associated with a special type of compound. Certain molecules or groups may have a stronger effect than others, but all types, whether ions or uncharged molecules, influence the dissociation of hæmocyanin.

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Elimination of Administered Chloral Hydrate in the Urine as a Test for Liver Function

WHILE engaged in studying certain phases of the toxicity of chloral hydrate to the organism, we have made some observations regarding its urinary elimination in normal and liver-damaged dogs which promises to offer a great deal of information regarding one of the most important functions of the liver, namely, its function of detoxication.

Chloral hydrate was one of the first hypnotic drugs to be used in therapeutics, and its action and ultimate fate in the body have been worked out fairly satisfactorily. It is now generally agreed that chloral is not broken down in the body but is reduced to an alcohol which is conjugated with glucuronic acid and is excreted as the innocuous compound, trichlorethylglucuronic acid (urochloralic or chloraluric acid). This method of excretion as urochloralic acid accounts for nearly the whole of the chloral administered, though some authorities think that a small part of chloral may be excreted unchanged and, at most, minimal traces as inorganic chlorides and chloroform[1]. The reaction is represented as follows :

$$CCl_3.CHO \rightarrow CCl_3CH_2OH + CHO.(CHOH)_4COOH \rightarrow CCl_3.CH_2.O(CHOH)_4COOH$$

Chloral — Trichlorethyl alcohol — Glucuronic acid — Urochloralic acid.

The liver has long been recognized as an organ which plays an important part in the process of conjugation with glucuronic acid. Recent researches by Hemingway *et al.*[2] on liver-kidney-lung-spleen-limb perfusion experiments have proved beyond doubt that this conjugation always takes place in the liver and nowhere else. Under normal conditions, therefore, that is, when the liver is functioning properly, any chloral that presents itself to the liver cells will be almost completely coupled with glucuronic acid, an apparently unlimited supply of which is obtainable in the body from the metabolism of carbohydrates or the glucogenetic amino-acids. If, however, the liver cells are damaged, due to the chronic ingestion of carbon tetrachloride for example, it is probable that this normal mechanism of conjugation will be disturbed, the liver cells failing to mobilize glucuronic acid to the same extent as under ordinary conditions. If the administered chloral is not completely and satisfactorily conjugated, free chloral may make its appearance in the urine.

Working on this hypothesis, we have estimated free chloral in 24-hour urine samples of normal and liver-damaged animals after administration of 200 mgm. per kilo. of chloral hydrate to dogs kept in metabolism cages on a standard diet. Liver-damage was brought about by the administration of 1·5 c.c. per kilo. body weight of carbon tetrachloride on alternate days (every third day whenever Sundays intervened) for eighteen weeks according to the method of Lamson and Wing[3]. The presence of free chloral in the urine was estimated by the method of Friedman and Calderone[4] with the modification that animal charcoal (1 gm. per 10 c.c. urine) was employed to decolorize completely the urine before starting the experiments. This treatment prevents the masking of the final pink colour of the reaction by the yellow pigment of urine. The results of a typical set of experiments are given in the following table.

It will be seen that, at least under the experimental conditions in our series, dogs with frankly damaged livers fail to conjugate chloral hydrate with

	Dog No.	Weight kgm.	Total excretion of free chloral hydrate in 24 hour urine after the administration of 200 mgm./kgm. of the drug. Figures given in milligrams				
			Days				
			1	2	3	4	5
Normal	4	5·5	*Nil	Nil	Nil	..	..
	5	4·7	Nil	Nil	Nil	..	..
Liver Damaged	1	6·3	30	15	12	20	40
	2	6·1	15	18	10	10	50

* 'Nil' indicates that either there is no free chloral hydrate in the urine or quantities less than 1 in 40,000 (0·025 mgm./c.c.) are present.

that degree of completeness characteristic of normal animals, thereby allowing significantly measurable quantities of free chloral to appear in the urine.

Although our series of experiments is small, we feel that this measure of chloral elimination after the administration of a known dose of chloral may be a valuable adjunct to the other methods of diagnosis of liver function, and an extended trial seems justifiable.

We are grateful to Colonel R. N. Chopra for giving us facilities and help in carrying out this investigation.

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Nature of the Growth-accelerating Substance of Animal Tissue Cells

EVER since a technique for cultivating tissue cells *in vitro* has been developed, the isolation of the growth-promoting substances in the embryo extracts has been an important subject of research. Several important facts have been discovered during the attempts to isolate the growth-promoting substance of the chick-embryo juice tested on cultures of tissue cells of fowls. These investigations led in some respects to erroneous results, for example, the statement of the extreme lability of the active principles.

Experiments have long since indicated that the growth-promoting substances are unspecific as regards the animal species. New facts obtained lately are in favour of the assumption that one substance only is responsible for the activity.

In using beef embryo extract a most active growth-promoting fraction was obtained by isolating the nucleoproteins by using the method of Hammarsten[1]. When these nucleoproteins are dissolved in water by careful addition of sodium hydroxide and added to the culture medium of tissue cells a pronounced growth-acceleration takes place. With these substances, strains of tissue cells can be maintained for long periods of time. The ratio of phosphorus to nitrogen in the active fraction is about 12 per cent, much lower than that found by Hammarsten for the nucleoproteins of the pancreas, namely, 33 per cent. The nucleic acids found in the active nucleo-proteins belong to the thymonucleic acid type as well as the ribose nucleic acid type. The growth-promoting activity seems in the meantime to follow the fractions containing the ribose nucleotides. After reprecipitations of the nucleoproteins with glacial acetic acid in excess, the precipitate is most active and contains a relatively great amount of the ribose nucleotides and very little thymonucleic acid, whereas the non-precipitated substances remaining in solution contain relatively much thymonucleic acid and less ribose nucleic acid. These facts seem to agree very well with the statements of Jorpes[2], Levene and Jorpes[3] and lately of Casperson[4] that the ribose nucleic acid was found in actively growing animal cells and thymonucleic acid in the resting cells.

The growth-promoting activity of the substance is destroyed after digestion with trypsin for a short length of time. Likewise the activity disappears after boiling for a few minutes. This indicates that the protein forms an important part of the active compound. Experiments have further shown that the active compound can be restored after coupling of two inactive components, the one thermo-resistant, the other thermo-labile—more likely the latter is the protein component. The active principle is probably of high molecular order since they are rather easily precipitated in the ultracentrifuge.

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The Last Thousand Feet on Everest: Possible Bacterial Factor

PROF. YANDELL HENDERSON, in his article in NATURE of June 3, p. 921, emphasizes some of the difficulties facing the members of the expeditions to Mount Everest. The main handicap is the small amount of oxygen which can be breathed in per minute from such rarified air as exists at 29,000 ft. Prof. Henderson refers to my experiments on animals, which show clearly that mammals cannot be fully acclimatized to live under an oxygen pressure below 10 per cent of an atmosphere such as exists above 20,000 ft. These results have been confirmed by attempts of South American sulphur miners to establish permanent villages near this level. The highest permanent village is at 17,500 ft.[1].

The experiments with animals show also that even resting animals, which are not specially exercised or exposed to special muscular effort, cannot tolerate for an indefinite period the degree of oxygen-want in the tissues such as is suffered in an atmosphere containing less than 10 per cent of oxygen. From the symptoms in man and postmortem findings in animals, it may be concluded that all systems and organs are adversely affected by such severe anoxia and naturally the most important are the vital organs, namely, the cardio-respiratory system and the brain. Any attempt to assign supreme importance to any one organ is not likely to be successful, although the postmortem

evidence indicates heart failure as the immediate cause of death. It seems that much more information regarding changes in the human organism at the last thousand feet might be obtained from clinical wards with patients suffering from severe oxygen-want.

Much has been written on various aspects of the physiological problems of high altitude, but above 20,000 ft. the problem enters the realms of pathology and clinical medicine. The physiology at the lower altitudes may therefore be of little help in elucidation of what is taking place in the human organism at excessive altitudes. Certain systems and organs have been very fully studied at the lower altitudes, and this tends to magnify their importance. However, one system, namely, the alimentary canal, has perhaps not received the attention it deserves.

In the course of some feeding experiments with white rats, evidence has been obtained that, under very low oxygen pressure, toxic substances accumulate in the gut. The toxic substances come from the food and from the tissues, but are probably oxidized under normal oxygen pressure and rendered harmless. Certain articles of diet, particularly certain proteins, seem to be most potent in producing these effects. By excluding these proteins from the diet, the resistance of the rats may be definitely increased. These adverse proteins include casein, egg albumin, meat and fish. Various other proteins have been investigated and zein, one of the proteins of maize, gives the best resistance, but a diet of whole maize alone is of no protective value. Adding zein to a maize diet improves the result, so that the zein appears to contain some favourable factor.

Certain amino-acids of the proteins have been tested separately, and adverse effects are obtained with histidine, cystine and arginine. Under bacterial action, histidine gives rise to histamine, which may cause collapse and shock. Collapse is a symptom also of severe anoxia. It is possible also that poisonous compounds of guanidine may arise from arginine. Resistance to oxygen-want is increased also in rats fed on diets containing adsorbents, such as charcoal, fibre or paper pulp, and kaolin. These may act by removal of toxic products from the contents of the alimentary canal. The most favourable foods for increasing protection against oxygen-want include carrots (the most protective), parsnips, beetroot, apples and bananas, all of which have a low protein content and also contain some fibre. As stated above, zein is the best of the proteins, with gelatin second, but not nearly so good. Starch, glucose, fat, vitamins and salts seem to be inactive—that is, they do not affect the result one way or the other, and therefore may be used in addition to the above more favourable articles of diet.

Undoubtedly, bacteria are responsible mainly for the adverse effects with most of the protein foods. Cats cannot tolerate the conditions at 14,000 ft., and this may be due to their protein diet. The variation in resistance observed in man may be due in part to variation in protein content of diet and to variation in bacterial flora in the intestine. The full details of the above experiments are being published elsewhere.

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Open Type Oxygen Apparatus

IT is suggested in NATURE of June 10 (p. 970) that the weight of this apparatus may possibly be still further reduced "by mechanical improvement of valves and cylinders"; and as weight reduction is so important, the question is worth considering. The first Vibrac (not Vibrax, as on p. 961) bottles ever made were used for the 33lb., 1,600 litre, 1924 apparatus. The weight of steel was thus reduced almost exactly from 4¼ to 3½ times the weight of oxygen, the former figure applying to the first, or 1922, apparatus. Subtracting 19 lb., given in Mr. Peter Lloyd's article as charged bottle weight for the latest 1,000 litre apparatus, from the total weight of 25 lb., we get 6 lb. as the rough weight of the rest of the gear. This compares with 8 lb. in 1924, when the flow meter was not omitted.

Further weight reduction by mechanical improvement seems doubtful, and the only hope is for metallurgists to produce a steel justifying a working stress higher than 27 tons/sq. in. That is the figure when Vibrac bottles are charged at Wembley to 120 atm., and the pressure is raised to 132 atm. owing to a shade temperature of 113° F., the record for deck cargo on the route of transit.

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An Experimental Attack on some Problems of Physiological Genetics

SINCE 1937, experimental work with *Drosophila melanogaster* on two problems of physiological genetics has been in progress in this laboratory.

(1) *Experiments on the development of the mutant* aristapedia (ss^a) *which transforms the bristle on the antenna* (*arista*) *into a tarsus.* In ss^a-flies segmentation of the antennal disk starts two days earlier than in normal flies[1]. Goldschmidt[2] therefore assumed that at 2½ days of larval age an evocator which determines leg segmentation is present in the germ, and all disks in the proper stage of development will react to this stimulus by tarsus formation. In normal flies the undeveloped antennal disk will not react to this evocator. In ss^a-larvæ, however, the differentiation of the antennal disk is speeded up and the antennal disk will react simultaneously with the leg disk in starting tarsus segmentation.

If this explanation is correct, a compound of ss^a with different leg mutants should show the mutant effect on the legs also, on the antenna of ss^a, and mutants influencing the arista should show no effect on ss^a. Confirmatory results were obtained in several tests. Compounds of ss^a with *dachs* and ss^a with *thickoid*, mutants which influence the length and the thickness of the legs respectively, showed these leg effects on the tarsus-like part of the antenna in ss^a. A compound of ss^a with aristaless, a mutant reducing the arista and influencing the scutellar bristles, showed no effect on the antennæ of ss^a, but its usual effect on the bristles could be observed. Transplantations of antennal disks were performed between 400 larvæ of ss^a and normal at different stages of larval age from 2½ days to pupation. ss^a-Disks transplanted into normal larvæ always developed into leg-like structures; normal antennal disks transplanted into ss^a-larvæ developed into normal antennæ with aristæ. The negative results of these transplantation experiments can probably be explained by the fact that

ss^a is determined at a very early larval stage (2½ days) prior to which successful transplantation is extremely difficult.

(2) *Experiments on the development of mutant wing characters.* With the help of an electrically heated needle, small defects were made during the developing young pupal wings. No significant effect could be detected on the degree of notched if vg^{no}-pupæ were operated on. However, a significant effect on the venation could be observed. If the defect was made on the basis of the wing at a pupal age of 12–18 hours, the distal cross-vein was mostly missing or reduced in the hatching flies. Pupal wings from *plexus* (*px*) and *net* stocks, mutants which show extra venation, were operated at the basis at the pupal age of 12–24 hours, and the hatching flies showed reduction in extra venation and the distal cross-vein. It was possible to get operated wings without any extra venation in *px* and *net* flies, while the other wing as unoperated control showed the *px* and *net* type clearly. Identical results were obtained after the defect was made by a cold needle.

Developmental studies indicated that the formation of the distal cross-vein and the extra venation takes place after the rest of the venation has been formed at 18–24 hours of pupal age. By operation at the pupal age of 12–24 hours, a general process of formation of veins is probably inhibited. The exact location of the defect does not seem to influence the degree and place of reduction of venation so long as the defect is placed in the proximal third of the pupal wing. Defects placed in the distal part of the wing result in destruction of distal parts without effect on the venation. Operations after 24 hours of pupal age result in local destruction of the tissue. Extreme changes in the shape of the wings were sometimes observed after operation. A detailed analysis of these studies will be published elsewhere.

A great part of these studies has been suggested by Dr. R. Goldschmidt. His advice and help are gratefully acknowledged.

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Energy of High-Velocity Neutrons by the Photographic Method

FOR many years it has been known that after the development of certain types of photographic plates, the tracks of any heavy ionizing particles which have passed through the emulsion are represented by a succession of developed grains. Several investigators have examined the question of the precision with which the length of the track can be taken as a measure of the energy of the particle. Opinion on the question has been divided[1,2,3], and the method has not come into general use for nuclear problems though several investigators are using it for work on the cosmic rays. If the method could be made precise, it would have great advantages over expansion chamber technique in dealing with certain types of nuclear problem. Recently, having made experiments with Dr. Heitler on the heavy particles in the cosmic radiation by this method, we decided to re-examine the question of its precision in detail. In view of the importance of developing more powerful methods of measuring neutron and gamma-ray energies, the results seem to us to suggest that the method merits the serious consideration of those engaged in nuclear research.

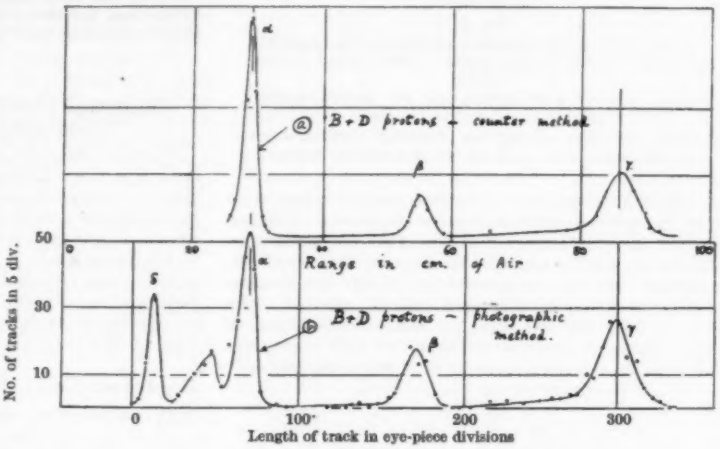

Fig. 1.

CURVE (*a*), B + D PROTONS BY COUNTER METHOD. CURVE (*b*), B + D PROTONS BY PHOTOGRAPHIC METHOD. PEAK δ DUE TO D + D PROTONS.

We first passed protons from boron under deuteron bombardment, through a mica window and tangentially into an Ilford 'half-tone' plate, measured the length of the 'tracks' and drew the appropriate range-frequency curve. The corresponding curve obtained by counting methods[4] is shown in curve (*a*), Fig. 1, and our results in curve (*b*), the two scales having been chosen to make peaks 'α' and 'γ' coincide. It will be seen that the resolving power of the photographic method is comparable with that of the counting experiments for protons in this range of energy. The results shown in Fig. 1 enable us to calculate the stopping power of the emulsion and hence the range of particles in peak δ. This turns out to be 14·8 cm. of air and is evidently due to particles from the D + D reaction.

We next passed neutrons, from various light elements bombarded with deuterons, tangentially through similar plates and measured the lengths of the 'tracks' of the directly knocked on protons. We could thus determine the neutron energies in a way analogous to that employed by Bonner and Brubaker[5,6] using the expansion chamber technique. Our results for B + D neutrons and for Be + D neutrons are shown in Figs. 2 and 3, together with the results obtained with the expansion chamber. It will be seen that the photographic method has a resolving power considerably higher than that achieved with the expansion chamber.

We would direct particular attention to the great saving in labour which the photographic method

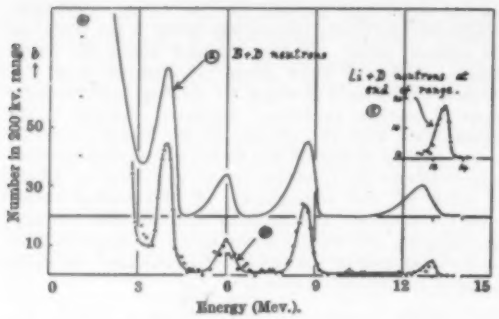

Fig. 2.

CURVE (*a*), B + D NEUTRONS BY EXPANSION CHAMBER METHOD. 1,000 TRACKS FROM 11,000 STEREOSCOPIC PAIRS.

CURVE (*b*), B + D NEUTRONS BY PHOTOGRAPHIC METHOD. 4 HR. EXPOSURE.

CURVE (*c*), END POINT OF ENERGY SPECTRUM OF NEUTRONS FROM Li + D BY PHOTOGRAPHIC METHOD.

affords. For the analysis of the energies of the neutrons from the Li + D reaction by the expansion chamber method, 20,000 stereoscopic pairs of photographs were taken from which 1,600 tracks were suitable for measurement. We have measured the energy distribution of these neutrons by the photographic method. The 3,000 tracks for the analysis are all contained in three square centimetres of an Ilford half-tone plate obtained in a single exposure of a few minutes.

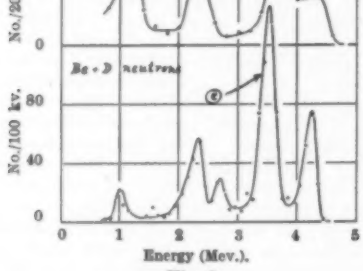

Fig. 3.

CURVE (*d*), Be + D NEUTRONS BY EXPANSION CHAMBER METHOD. 580 TRACKS FROM 3500 STEREOSCOPIC PAIRS.

CURVE (*e*), Be + D NEUTRONS BY PHOTOGRAPHIC METHOD. 20 MIN. EXPOSURE. 960 TRACKS. INTENSITY OF 1 MEV. PEAK LOW IN COMPARISON WITH OTHERS DUE TO IGNORING SHORTER TRACKS.

For experiments with neutrons the photographic method has the following important advantages: (*a*) It is equivalent to a continuously sensitive high-pressure expansion chamber. (*b*) It involves a minimum of material and does not give rise to disturbing scattered neutrons. (*c*) The photographic plate is small and can be placed very near the neutron source, with a corresponding gain in intensity. Many quantitative experiments with neutrons become possible, because of these advantages, which could not be seriously considered with the expansion chamber technique.

A complete description of the experiments in which we have examined the energies of the neutrons from all the light elements under deuteron bombardment and a discussion of further applications of the method will be published shortly.

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Directional Distribution of the Hard and Soft Component of Cosmic Radiation

WITH a two-fold coincidence apparatus we have determined the intensity distribution of cosmic radiation in the north-south and east-west planes. The measurements were made in all four directions with zenith angles (δ) varied by 5° steps from the vertical to the horizontal. Every position was measured once with no absorber and a second time with 36 cm. lead between the counters. From the results it is possible to determine independently the directional distribution of the hard and of the soft component:

$$\text{Hard component:}\quad R(\delta) \times 10^4 = 2 + 59\cos^2\delta \qquad (1)$$

$$\text{Soft component:}\quad R(\delta) \times 10^4 = 3 + 27\cos^{9\cdot5}\delta \qquad (2)$$

The intensities are given in coincidences per cm²/sec./unit solid angle. The following interpretation of these results seems to us justified.

The intensity of the hard component can be resolved into the intensity of two factors. The first represents the meson intensity, giving rise to a variation corresponding to $\cos^2\delta$. Assuming that the majority of the mesons are created at a height equivalent to about 8 cm. mercury pressure, below the top of the atmosphere, further that the number of the mesons created there with energies greater than E is given by

$$N = \text{constant}/E^{\gamma}, \qquad (3)$$

with[1] $\gamma = 1{\cdot}8$, and that the meson intensity decreases chiefly through spontaneous decay, thus it will be a function only of the distance between the place where they have been created and the observer:

$$J = \text{const.}\int_{E_1}^{\infty} \frac{e^{-lE_0/\tau cE}}{E^{\gamma+1}}\,dE \sim \frac{\text{const.}}{l^{\gamma}}; \qquad (4)$$

where τ is the life-time of the meson at rest ($\sim 10^{-6}$ sec.), E_0 is the energy of the meson at rest ($\sim 8 \times 10^7$ ev.), c is the velocity of the light, E_1 is the energy necessary to travel through the atmosphere ($\sim 2 \times 10^9/\cos\delta$ ev.), l is the distance of the observer from the place where the mesons were created.

A pressure of 8 cm. mercury in a vertical direction corresponds to a height of about 16 km. For more inclined directions we must take into consideration that a meson created at 8 cm. mercury below the top of the atmosphere will be in this inclined direction

at a greater height from the observer at sea-level even when measured vertically. Thus for the distance measured in the inclined direction we obtain:

$$l = \frac{1}{\cos\delta}\left(16{,}000 + 14{,}620 \log \frac{1}{\cos\delta}\right) \approx \frac{\text{const.}}{\cos^{1\cdot 3}\delta} \qquad (5)$$

(For greater elevations such as 11 km. use the barometric formula: $\Delta h = 14{,}620\ (\log\ p_1 - \log\ p_2)$ metres.)

From (4) it follows that the intensity varies inversely as $l^{1\cdot 3}$; together with (5) we may compute that the intensity must vary according to $\cos^{2\cdot 3}\delta$; the experimental result being a $\cos^2\delta$ variation.

The second part of the intensity of the hard component consists of heavy particles created by neutrinos in multiple showers, the neutrinos themselves being a product of the meson decay[2]. It is, however, not quite excluded that neutrinos with magnetic moment are able to produce a coincidence with the help of two soft secondary electrons[3]. It can easily be seen that this part of the intensity should be invariant for every direction, since (1) the meson intensity can be taken as uniformly distributed over all directions at the place of origin; (2) the majority of the mesons are already disintegrated before they reach the apparatus, thus the number of the neutrinos will only slightly increase in more inclined directions through the number of those produced in further decay; and (3), on the other hand, the decrease in the number of the neutrinos in the inclined direction will also be negligible on account of their small absorption. This constituent of the intensity corresponds to the first term on the right hand side of (1).

In the case of the soft component, we can again distinguish two parts, the first consisting of electrons produced at the disintegration of the mesons, or cascade electrons created by them. This part of the intensity should vary according to the meson intensity, that is, with $\cos^{2\cdot 3}\delta$; but we must also take into account that the probability with which the decay occurs in the region surrounding the apparatus is inversely proportional to the energy of the meson. Thus the intensity will be expressed now by

$$J = \text{const.} \int_{E_1}^{\infty} \frac{e^{-lE_0/\varepsilon E}}{E^{\gamma+1}} \frac{\mathrm{I}}{E}\, dE \sim \frac{\text{const.}}{l^{\gamma+1}}; \qquad (6)$$

and we get finally from considerations analogous to those above that this part of the soft component should vary as $\cos^{3\cdot 6}\delta$. The experimental results are in good agreement with a variation corresponding to $\cos^{3\cdot 5}\delta$, the second term on the right hand side of (2).

The second constituent of the soft component furnishes again a constant intensity. It consists of electrons created by neutrinos. The same considerations as above hold also in this case; thus this part, corresponding to the first term in (2), should be invariant for all directions. We believe we have found here an explanation why the relative intensity of the soft component increases again not only for more inclined directions but also at very great depths[4].

So far as the reliability of the measurements permit, we are able to estimate the amounts of the different kinds of radiation observable at sea-level from the vertical direction. 65 per cent of the radiation consists of mesons, 30 per cent of electrons produced in meson decay or cascades initiated by them, 5 per cent of electrons and heavy ionizing particles created by neutrinos.

We wish to express our gratitude to the Hungarian Council for Natural Science, and the Hungarian Academy of Science for financial support.

J. BARNÓTHY.
M. FORRÓ.

Institute for Experimental Physics,
University, Budapest.
May 27.

[1] Euler, H., and Heisenberg, W., *Erg. d. exact. Naturwiss.*, **17**, 38 (1938).
[2] Yukawa, H., *Proc. Phys. Math. Soc. Jap.*, **19**, 712 (1937).
[3] Bethe, H., *Proc. Camb. Phil. Soc.*, **31**, 108 (1935).
[4] Barnóthy, J., and Forró, M., *Phys. Rev.*, **55**, 870 (1939). On 1,000 m. water-equivalent depth, about 50 per cent of the radiation consists of soft particles.

Effect of an Electric Field on the Viscosity of Liquids

Prof. E. N. da C. Andrade and C. Dodd have described[1] their investigations of the effect of an electric field on the viscosity of a number of organic liquids. They state that they found an increase of viscosity of up to 60 per cent in polar liquids, while non-polar liquids showed no increased viscosity.

We would point out that work of a similar kind was performed by us in 1935[2].

We succeeded in showing that the increase of viscosity, which in some cases was more than 100 per cent, is due to the passage of the electric current through the liquid. Increased viscosity was also observed in non-polar liquids (benzene, hexane, carbon tetrachloride) when the latter had been artificially contaminated by the addition to the pure preparations of a few drops of the same liquid saturated with hydrochloric acid vapour, or of a few drops of acetone. In our opinion, this seeming increase of viscosity in a liquid under the action of an electric field is a purely hydrodynamic phenomenon due to the convection of a non-homogeneous liquid placed in an electric field.

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[1] NATURE, **143**, 26 (1939).
[2] *Acta Physicochimica U.R.S.S.*, **5**, 691 (1936).

WE are sorry that the interesting paper of Sokolow and Sossinski, referred to in the above letter, escaped our notice, and we are very glad that our attention has now been directed to it. We agree that in it the authors clearly established a large effect of electric field on the apparent viscosity of polar liquids, and that the effect is accompanied by the passage of an electric current, both of which facts are among our observations. We think, however, that the method which Sokolow and Sossinski used, namely, a capillary of square cross-section, with the field applied to two opposite sides, is less precise than our disposition: we used a capillary of rectangular cross-section, with side ratio 1 to 50, and the potential applied to the long sides. In our case the field is uniform; in the other case, owing to differences of dielectric constant between liquid and glass, it is far from being homogeneous, which may be one of the causes of certain discrepancies which we have noted.

Owing to the fact that the upper limit of the fields used by Sokolow and Sossinski was 17 kv./cm., while our fields went up to 40 kv./cm., the Russian workers were unable to observe the saturation effect, namely,

that the viscosity-increase becomes constant at high fields, which was one of the most striking of our results. This saturation is not accompanied by a saturation of current, which shows that the close relation between current and viscosity-increase suggested by Sokolow and Sossinski is unlikely to be correct. Their comparatively small number of frequencies and small range of frequency in the case of alternating potential, namely, the two frequencies 50 and 1,000 cycles/sec., as against our range of 0 to 10,000 cycles/sec., with determinations throughout the ranges, prevented them obtaining our effects in this part of the work. They have not calculated the effect which a low-frequency alternating current should have if at each stage static equilibrium existed between field and viscosity increase. If allowance for the variation of potential is made, we find that for 50 cycles/sec. the effect is the same as at a steady potential.

We believe that their explanation, that the effect is due to hydrodynamic convection, is not tenable in view of our results. It will not explain either the saturation at large fields or the lack of parallelism between current and viscosity increase. The conditions of Hofmann's experiments, on which Sokolow and Sossinski base their argument, are so different from those of our experiment that we do not think they are applicable. The explanation is also not in accordance with later experiments of ours which were not referred to in our letter in NATURE. In these we have carried out experiments with three different gaps, namely, 0·2 mm., 0·22 mm. and 0·28 mm., and have found that the effect at constant field, in terms of volts per cm. of gap, diminishes as the gap increases. This is one of the facts that led us to attribute the effect to the building up of comparatively rigid ionic layers on the opposite walls of the channel, layers which reach a limiting thickness at high fields. Assuming a constant thickness at saturation, we are able to explain quantitatively the influence of gap width on the effect.

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A New Model of the Point Charge Electron and of Other Elementary Particles

WE wish to introduce a point charge electron which conserves a number of properties of the Lorentz electron and which can be taken over into quantum theory without any difficulties.

The Lorentz model of the electron (a charge e spread over a region of space of the order of a certain fundamental length l) is a satisfactory description of classical optics of wave-lengths $\lambda > l$. If $\nu^{-1} = \lambda \gtrsim l$, this theory contains the classical analogue of 'showers'. This can be seen from the equation of movement of the co-ordinates $q_\alpha(t)$ of the centre of the electron. If the electric field is decomposed in an external field E'_α ($\alpha = 1,2,3,$) and the retarded field of the charge density $e\rho(x_\alpha - q_\alpha)$, this equation takes the form (if $\dot{q}_4 = 0$*):

$$e^2(2l)^{-1}\ddot{q}_\alpha + e^2\sum_3^\infty \sigma_n l^{n-3}((\ddot{q})^{n-1}\ddot{q}_\iota + \ldots) = (2/3)e^2\ddot{q}_\alpha + \int dx^3 \rho E'_\alpha \quad \ldots \quad (1)$$

The term proportional to l^{n-3} superimposes on the periodic movement of frequency ν an additional oscillation with the frequency ν/n. The quantum interpretation of the emitted radiation is the Compton effect and the simultaneous emission of n quanta of energy $h\nu/n$.

$e^2(2l)^{-1}$ is the mass due to the energy of the electrical and the (non-electrical) cohesive forces in the electron. We use the four-vector of the electrodynamic potential A_i to describe the electric, and a real and scalar potential ψ to describe the cohesive forces. $e\rho_\alpha = eq_\alpha\varrho$, $e\rho_4 = i\varrho$ and $e\rho_\psi = e\sqrt{1-\dot{q}^2}.\varrho$ are the four-vector of charge density and a real and scalar density which produce the fields A_i and ψ.

Let $L(A_i)$ be the Lagrangian of electromagnetism and $L(\psi)$ that of the ψ-field. The field equation and the equation of movement for $q_\alpha(t)$ follow from a variation principle based upon the Lagrange function:

$$L = L(A_i) + L(\psi) + \rho_i A_i + \rho_\psi\psi \quad \ldots \quad (2)$$

This theory has the remarkable property that the total energy of a charge at rest tends to $e^2(2l)^{-1}$ if the charge distribution tends to a point charge: $\rho(x_\alpha) \to \delta(x_\alpha)$. l signifies now the *fundamental length* introduced by the Yukawa field (and *not* the radius of the charge distribution). The equation of movement has been derived elsewhere[1]. In the limit of a point charge, equation (1) of the Lorentz electron results. Therefore our point electron conserves all properties of the Lorentz electron including the 'shower terms'. If $\nu > l^{-1}$, ψ-waves are emitted, the quanta of which are neutral particles of $2h/e^2 = 274$ electron masses.

Because of the point character of the charge, quantization presents no formal difficulties. If L does not contain any non-classical (spin) terms, all the classical formulæ remain valid. The electron has a finite self energy $H_0 = e^2(2l)^{-1}$.

If the spin terms of the form $el\gamma_\varsigma\gamma_k\delta A_i/\delta x_k$ occur, we have to add a pseudoscalar potential ψ_{1234} (which leads to terms $el\gamma_\varsigma\gamma_k\gamma_\tau\delta\psi_{ik\tau s}/\delta x_s$) in order to obtain a finite self-energy. Analogous considerations hold for the heavy particles the L of which contains isotope spin' terms and the complex meson field Φ_i. In order to arrive at finite self-energies, the formulæ of Kemmer[2] can be applied. Due to the complications[3] arising from the non-commutability of these terms, H_0 will be a complicated function of $e^2(2l)^{-1}$. It is hoped that this function converges only for certain values of H_0 and so explains the discrete masses of the elementary particles actually observed.

E. C. G. STUECKELBERG.

Institut de Physique,
Université, Genève.
June 21.

[1] Stueckelberg, *C.R. Acad. Sci.*, in the press.
[2] Kemmer, *Proc. Roy. Soc.*, **166**, 127 (1938).
[3] Stueckelberg, NATURE, **143**, 560. (1939).

* The velocity of light is put equal to 1. σ_n are numerical constants.

Toxicity of *Salvia reflexa*

MINT weed (*Salvia reflexa*) has been shown to be responsible for heavy losses of stock in Queensland[1]. Chemical investigation of the plant failed to demonstrate the presence of any of the poisonous principles commonly found in plants. Following on the work of Rimington[2] with *Tribulus*, we were led to investigate the nitrate and nitrite content of *S. reflexa*, and the possibility that methæmoglobinæmia due to nitrite poisoning would follow the ingestion of the plant. The dried plant was found to contain up to

5 per cent of nitrate calculated as potassium nitrate, and an enzyme is present in the plant capable of reducing nitrate to nitrite, apparently through oxidation of glucose.

Two pounds of the dried plant mixed with water, allowed to stand for twenty hours and fed to a sheep, produced fatal methæmoglobinæmia, the oxygen-carrying capacity of the blood being reduced in five hours to approximately 30 per cent of the normal.

Furthermore, the higher nitrate content of the plant[3] is of itself capable of being toxic without the intervention of the reducing enzyme and was shown in subsequent experiments. We suggest that *Salvia reflexa* may be typical of a group of plants which under appropriate conditions can accumulate nitrogen as nitrate very rapidly and thus at times be poisonous to stock.

A full account of this work will shortly be published in the *Australian Veterinary Journal*.

C. H. WILLIAMS.
H. J. G. HINES.

University of Queensland,
Brisbane.
May 29.

[1] Commonwealth Council for Scientific and Industrial Research. Pamphlet No. 49. Melbourne (1935).
[2] Rimington, C., *South African J. Sci.*, **30**, 472 (1933).
[3] Cf. Seekles, L., and Sjollema, B., *Arch. wiss. prakt. Tierheilkunde*, **65**, 331 (1932).

Salaries of Scientific Workers

IN NATURE of July 1 there appears an advertisement asking for applications for a post under the Ministry of Agriculture and Fisheries, which requires a botanist with an honours degree and at least two years experience of research in systematic botany. The starting salary offered is £155 per annum. We would like to point out that this salary is not only incommensurate with the training required, but is also far below the normal salaries obtaining in Government departments for men of science holding equivalent qualifications.

In the same issue of NATURE there is an advertisement under the name of University College, Southampton, requiring the services of a research assistant of graduate standing who will receive free board and residence and a remuneration of £50 per annum. We also wish to direct attention to the salary offered, £250 a year, in the same advertisement for the post of superintendent of the Branch for Southern Rivers, Freshwater Biological Association.

REINET FREMLIN.
(Secretary.)

Association of Scientific Workers,
30 Bedford Row,
London, W.C.1.
July 4.

Points from Foregoing Letters

F. Kögl and H. Erxleben state that the method used by Chibnall *et al.*, although very suitable for the isolation of natural glutamic acid, appears not to be applicable for detecting the partial racemization of glutamic acid in hydrolysates from tumour proteins. The presence of racemic glutamic acid in tumour proteins was shown by the isolation of the *d*-form.

S. Brohult and S. Claesson have investigated the influence of different types of salts and of some non-electrolytes on the dissociation of the hæmocyanin molecule. The dissociation reaction, usually reversible, seems to be of a general type, as it is caused by ions as well as by uncharged molecules.

B. Mukerji and R. Ghose suggest a new method for measuring liver function. Under ordinary conditions, no free chloral appears in the urine of dogs given this substance. When the liver is damaged by the chronic administration of carbon tetrachloride for 18 weeks, appearance of free chloral in significant amounts following the administration of the drug was observed in the urine.

Albert Fischer states that the growth-promoting principle of embryo extract is found in the fraction of nucleoproteins isolated by the method of Hammarsten. The ratio of phosphorus to nitrogen is rather low. The active fraction contains ribose nucleotides and very little thymonucleic acid. The activity is destroyed after digestion with trypsin and after boiling for a few minutes. Restoration has been possible after coupling of two inactive components. Precipitation in the ultracentrifuge indicates that the active principle is of high molecular order.

Evidence has been obtained with white rats by J. Argyll Campbell that under very low oxygen pressure toxic substances accumulate in the intestine. Certain proteins, for example, casein, egg albumin, meat and fish, in the diet give adverse effects. Certain amino acids, for example, histidine, arginine and cystine, also give adverse effects. Bacteria are held responsible for the toxic substances.

Werner Braun reports on some experimental work in physiological genetics. Using the fruit fly as material, he records experiments on the development of the mutant responsible for the transformation of the bristle on the antenna into a tarsus, and on the development of mutant wing characters.

C. F. Powell and G. E. F. Fertel have developed a technique for the determination of the energy of protons and neutrons by measurement of tracks made by these particles on special photographic plates. For many investigations the method has great advantages over the expansion chamber technique.

J. Barnóthy and M. Forró find that the results obtained by measuring the directional distribution of the soft and hard component of cosmic radiation can be explained by assuming that the radiation at sea-level consists of 65 per cent mesons, 30 per cent electrons produced in meson decay, and 5 per cent of electrons or heavy ionizing particles created by neutrinos, this part of the intensity being invariant for all directions.

S. Sossinski points out that he and Sokolow published in 1936 work in which they showed that an electric field has a great effect on the viscosity of polar liquids, a fact to which attention was recently directed by Andrade and Dodd, and suggests a hydrodynamic explanation. E. N. da C. Andrade and C. Dodd, in reply, regret that they overlooked the paper in question, and point out that their work goes much beyond that of Sokolow and Sossinski. They suggest that the effect is due to the building up of comparatively rigid ionic layers on the opposite walls of the channel.

E. C. G. Stueckelberg derives an expression for a point charge electron which can be taken over into quantum theory.

RESEARCH ITEMS

Biology of Cerambycid Beetles

C. F. C. Beeson and B. M. Bhatia have published an article "On the Biology of the Cerambycidæ", in which they present data collected during twenty-four years on the food plants, distribution, life-cycle and other biological features of 350 species of this family of beetles from India, Burma and Ceylon (*Ind. Forest Rec.*, Ser. Entom., **5**, No. 1; 1939). The total number of species of Cerambycidæ, or longicorn beetles, known to occur in the Indian region is 1182. It appears that the sal (*Shorea robusta*) is the tree which supports the largest number of species, some 37 different Cerambycidæ being known from it. The beetle *Stromatium barbatum* is recorded to have no fewer than 311 different food plants, which indicates a very unusual range of polyphagy. The food plants of at least 250 species of these insects have not been previously published, and a total number of 568 species of Indian trees, shrubs and woody climbers is now known to be attacked by one or more kinds of Cerambycids. *Hoplocerambyx spinicornis* is potentially the most injurious forest insect in India. This is partially due to its liability to cause bad epidemics among the sal forests. Even a small outbreak of this insect, affecting eight square miles of forest in the United Provinces, resulted in 45,000 trees being killed, representing nearly a million cubic feet of timber. The most serious epidemic was estimated to have attacked about seven million trees before it was checked. The new data given for the biology, etc., of this species are more complete than for any other: for many of the species little more than the host tree and the locality are at present available. It is mentioned that sun-loving or diurnally active species may frequent the foliage and flowers of trees without any of them breeding as larvæ in the wood or feeding as adult beetles on the foliage or other parts of such trees.

Ring Spot Disease of Lettuce

THE fungus *Marssoniana Panattoniana* in epidemic form rapidly destroys lettuce seedlings and may also destroy older plants. Even a mild attack causes browning and perforation of the leaves which give rise to the name 'ring spot'. The disease is an important one in England, and has at various times caused considerable damage in Europe and America. Winter lettuce is the crop most affected, the disease being rare on plants grown under glass or planted out in spring. Experiments carried out over three years by Greta B. Stevenson at the Biological Field Station of the Imperial College (*J. Pom. and Hort. Sci.*, **17**, 27; 1939) have shown that the disease is readily transmitted by seed. Diseased plants gave apparently good seed which, however, under suitable conditions produced a heavily infected crop. On the other hand, sprayed and segregated mother plants gave seed which produced healthy plants where commercial seed gave valueless crops. The disease may also be contracted from the remains of a previous infected crop, though such remains normally lose their infectivity after about eight months. A similar fungus was found on a common weed (*Crepis capillaris* Wallr.) growing near diseased plants, and it is believed that this may be a source of infection. Sixteen commercial varieties of lettuce were all found to be equally susceptible to ring spot. Reduction of the disease was affected by spraying the seedlings with Bordeaux mixture (3 : 6 : 50) and by treatment of the seed with a filtered 10-per cent solution of bleaching powder.

Chemistry and Genetics

IN a paper given before a joint meeting of a number of American Societies (*Amer. J. Bot.*, **26**; 1939), A. E. Blakeslee points out the growing importance of chemistry in genetics and other branches of botany. The paper is concerned mainly with the results achieved by treatment of plants by solutions of colchicine, a toxic substance which has proved remarkably effective in inducing polyploidy. It is recognized that polyploidy following hybridization has been a feature in the evolution of some species and the use of colchicine provides a means whereby such allotetrapoids (multiple diploids) may be produced at will from sterile hybrids. This fact alone opens great possibilities in plant breeding. Other possibilities are also outlined in a survey of induced variations of chromosome number in *Datura*. Reference is also made to the little explored field of chemistry in relation to genetical characters. It is described how two externally similar types of *Rudbeckia* can be readily distinguished by their colour reaction with caustic potash or caustic soda. It is quite possible that in other cases also simple reactions might be employed to distinguish between similar homozygous and heterozygous types, thus enabling much economy in breeding experiments. Some problems of cytology and propagation which might have light thrown upon them by such methods are discussed at the end of the address.

Chromosome Numbers for the British Flora

THE *New Phytologist*, **38**, No. 1, May 1939, contains under the heading of "The Merton Catalogue" a first attempt to provide chromosome numbers for the species of the British flora, compiled by Pamela F. Maude of the John Innes Horticultural Institution, Merton. Such a list is, of course, incomplete at the present time, but that it can be attempted shows that cytologists have been much more thorough in their attack on the native flora than is generally realized, and the list, with its numerous gaps, is a stimulus to further work and gives invaluable indications where such work is particularly needed. The list reveals that of 526 British genera of flowering plants, 444 have been examined, and of 2,256 species in the London Catalogue, numbers can be supplied for some 1,300. Authorities are cited in each case, usually the latest reference being cited, but, at times, the preference is for a more important reference or to a more accessible (European) paper. This catalogue will be invaluable to both systematist and cytologist. It is published under the auspices of the Association for the Study of Systematics in Relation to General Biology.

Chromosomes of the Sawflies

THE characteristic diploid chromosome number in the Tenthredinidæ, the sawflies, is sixteen, although in Claudius and a few other species allied to this genus the number is twelve. A. D. Peacock and Ann R. Sanderson have investigated the cytology of another sawfly, *Thrinax macula* Kl. (*Trans. Roy. Soc. Edin.*, 1939), in which the diploid number is fourteen as found in the blastoderm, follicle cells, oogonia, oocytes and polar nuclei. This species is a female-producing parthenogenetic one in which, however, rare males sometimes make their appearance. Some of the latter were fortunately found and they appear to be haploid with a chromosome number of seven. During the maturation of the egg only one non-reductional division takes place in which there is neither synaptic pairing nor tetrad formation. The diploid number is presumably maintained in this species by the omission of synapsis, as is probably the case in the majority of parthenogenic animals in general. It is to be noted, however, that two maturation divisions do occur in some female-producing parthenogenetic sawflies. During spermatogenesis the first maturation division is abortive and the second is equational, as is commonly found in the Hymenoptera.

Chromosome Rearrangements in Drosophila

B. P. Kaufmann (*Genetics*, **23**, 154; 1938; **24**, 101; 1939) and B. P. Kaufmann and Ruth C. Bate (*Proc. Nat. Acad. Sci.*, **24**, 368–371) have analysed some chromosomal abnormalities in the progeny of X-rayed *Drosophila melanogaster*. One individual showed a duplication *abcdgfeefgh* in the nature of a 'reversed repeat'. This is shown to have arisen from the breakage and reunion of two sister chromatids derived from one paternal chromosome. Complex configurations were found. One configuration involved ten breaks and attachments, of which five were in one chromosome arm. Another showed that both chromatids of the duplicated section had been broken at two similar loci accompanied by a third break in each of the chromatids which had occurred at different loci.

Position Effect

HAIRY wing (*Hw*), a well-known and much used dominant character near the distal end of the *X*-chromosome of *Drosophila melanogaster*, has been shown by M. Demerec and M. E. Hoover (*Genetics*, **24**, 68, 271–277; 1939) to be due to a duplication of a single band of a salivary gland chromosome. This band is known to be associated with achæte (*ac*), which reduces the dorso-central bristles. Further, as in Sturtevant's Bar case, it is shown that when two bands are represented on one chromosome they have a greater effect than if they were distributed between two chromosomes. Unfortunately, no case of crossing-over between the two bands has yet been observed. This may probably be due to the fact that crossing-over is normally low in the region *y–sc* where *Hw* is placed.

Heterosis

L. C. LUCKWILL (*J. Genet.*, **37**, 421–439) has investigated the stage in the life-cycle of hybrid tomatoes at which heterosis is manifested. There was little correlation between heterosis in the seed and in the mature plant. In some hybrids heterosis was present in the shoot primordium on the 16th day and persisted until the 145th day, while in other hybrids heterosis arose subsequent to the 16th day. The author considers that in intraspecific hybrids heterosis may be dependent on complementary size determining genes as visualized by Jones. For inter-specific hybrids, however, he produces evidence to support East's hypothesis.

Structure of South-east England

DEFINING South-east England as the region lying south and east of the main chalk escarpment between Dorset and The Wash, S. W. Wooldridge and D. L. Linton have written a closely reasoned monograph on the development of its structure and relief ("Structure, Surface and Drainage in South-East England". Institute of British Geographers Publication No. 10. 1939. 12*s*. 6*d*.). The broad lines of the structure of this area are well known, but the two authors have added much detail and traced in lucid fashion the genetic development. They begin with the early Palæozoic floor. Particular interest is attached to the concealed junction of the Armorican and Caledonian structures which runs beneath the Lower Thames Valley. Southwards the cover rocks show competent folding and northwards only gentle flexuring. After the emergence of the chalk floor, a full-cycle of erosion ran its course and the greater part of the area lost its upper divisions of the chalk. The mid-Tertiary flexures south of the Thames and the mid-Tertiary foldings and the subsequent production of the late Miocene and early Pliocene peneplain are then traced. The invasion of the Pliocene sea and the emergence of the Pliocene sea-floor followed, and the lower Thames is shown to have had a course well north of its present channel. Then came the effects of the Chiltern and eastern ice sheets and the general subsequent uplift of the area. The monograph is well illustrated by maps and diagrams.

Range of Possible Existence of Stoneley Waves

THIS problem has been studied by K. Sezawa and K. Kanai (*Bull. Earthquake Res. Inst.*, Tokyo Imp. Univ., **17**, Part 1, 1–8; March 1939). First they obtained the velocity equation for waves of this type which are particular forms of Rayleigh waves, and from this equation calculated the velocity of transmission in the critical conditions of the equation which allow waves of this type to exist. From tables and graphs in two limiting cases of Poisson's ratio, it is seen that Stoneley waves exist within a narrow range of μ'/μ for every ratio of ρ'/ρ. The authors point out that this feature is remarkable, particularly when the ratio of ρ'/ρ is nearly unity, at which condition Stoneley waves could not exist unless Wiechert's condition, $\rho'/\rho = \mu'/\mu$, be almost satisfied. On the other hand, when the ratio of ρ'/ρ is relatively small, say less than 0·5, or relatively large, say greater than 2, the range of μ'/μ in which Stoneley waves exist is relatively wide, Wiechert's condition being then rather unimportant. The greater the ratio ρ'/ρ, the greater the ratio μ'/μ for the real existence of the waves. The velocity of transmission of the waves is independent of the wave-length, that is, they are not dispersive. It is likely that in between the critical values the velocity of transmission is less than either one of the velocities of distortional waves in both media. The waves are found not to exist for the range $0{\cdot}563 > \mu'/\mu > 0{\cdot}4927$, the

corresponding velocities of transmission ranging between $\sqrt{\mu/\rho}$ and $0{\cdot}9926\sqrt{\mu/\rho}$, where ρ, ρ', are the densities and μ, μ', the elastic constants of the adjacent media.

Structure of Vitamin B_6

VITAMIN B_6 is that factor of the vitamin B complex which prevents or cures an acrodynia-like dermatitis in young rats. If factor 2 is added to the usual thiamin and riboflavin supplement, vitamin B_6 not only produces a cure of the dermatitis but also a stimulation of growth. It has also been found that a severe microcytic hypochromic anæmia developed in puppies when the rat antidermatitis factor (vitamin B_6) was apparently the only missing component of the diet, and the anæmia was cured by the addition of this factor to the diet. The constitution of vitamin B_6 has now been established by a group of workers in the research laboratory of Merck and Co., Inc. (*J. Amer. Chem. Soc.*, **61**, 1237–1247; 1939), whose results confirm those obtained by Kuhn and co-workers published this year. The vitamin was isolated from rice bran as the hydrochloride $C_8H_{12}O_3NCl$ of a base $C_8H_{11}O_3N$(m.p. 160°). The methyl ester of vitamin B_6 was oxidized to a lactone and a dibasic acid. The acid was shown to be 2-methyl-3-methoxypyridine-4, 5-dicarboxylic acid and vitamin B_6 to be 2-methyl-3-hydroxy-4, 5-(hydroxymethyl)-pyridine. The 3-cyano-4-ethoxymethyl-6-methyl-2-pyridone was made from ethoxyacetylacetone and cyanoacetamide. This 2-pyridone derivative was used for the synthesis of the lactone of 2-methyl-3-methoxy-4-hydroxymethyl-5-carboxypyridine and the 2-methyl-3-methoxy-4, 5-pyridine dicarboxylic acid. This lactone and this acid were found to be identical with the lactone and dibasic acid obtained by the oxidation of the methyl ether of vitamin B_6, and the latter was thus proved to be 2-methyl-3-hydroxy-4,5-di-(hydroxymethyl)-pyridine. A complete synthesis of vitamin B_6 from ethoxyacetylacetone and cyanoacetamide was accomplished. The synthetic vitamin B_6 hydrochloride was shown to be identical with the natural product. A single dose of 100 gamma of the synthetic vitamin B_6 hydrochloride gave a curative effect which paralleled that of the natural vitamin B_6.

Metabolism of Chloronaphthalenes

R. V. Cleary, J. Maier and G. H. Hitchings (*J. Biol. Chem.*, **127**, 403; 1939) have studied the metabolism of a mixture of polychloronaphthalenes. The substance was found to be absorbed completely when given in olive oil solution to albino rats in doses up to 15 mgm. per day. No significant storage of the material could be detected in lung, liver, skin or kidney, nor was any significant amount excreted in the urine. Both the rat and dog apparently were able to remove and excrete the chloride promptly. A rise in the urinary ethereal sulphate fraction, but no significant change in the neutral sulphate excreted, was noted following chloronaphthalene feeding in the dog.

Testing of Electric Fuses

IT is of considerable importance to know the time necessary for the melting of fuses upon the occurrence of an electric short circuit. This time must be short enough to prevent damage to the apparatus or to the lines in series with the fuse, before the fuse has melted. It is particularly important in the cases of branches of a network, which is protected by a main fuse, when each branch contains an auxiliary fuse. These fuses protect the main fuse, so that the 'blowing' of one of them does not disturb the other branches. In a paper in the *Philips Technical Review* of April, by J. A. M. van Liempt and J. A. de Vriend, an easy method is described of testing fuses by a cathode ray oscillograph. The melting time of a fuse depends on the short-circuit current. If this time is sufficiently short to allow the dissipation of the heat being neglected, then the short-circuit current is several times the limiting current, that is, the maximum current the fuses can carry for unlimited time. G. C. Meyer found in 1906 that the melting time could be expressed by a formula. He found that if the fuses were initially at room temperature, then the time multiplied by the square of the short-circuit current equals a constant for a given material which is called the relative inertia constant. The value of this constant, for example, may be 1,000 for copper and 40 for lead. By recording the current at the moment of the melting of the fuse as a function of the time until it melts with the aid of a cathode ray oscillograph, the short-circuit current and the time can be determined from the same oscillogram. The authors also show how the measurement can be made with alternating current. In this case it is simplified, as for the calibration of the time no separate oscillogram is necessary, the time-scale being read off immediately from the oscillogram for the calibration of the current.

Supernovæ

H. ZANSTRA (*Occasional Notes, Mon. Not. Roy. Astro. Soc.*, No. 4, March 1939) has dealt with the main characteristics of these objects. Some of these extra-galactic novæ have a brightness equal to nearly 100 million suns, a remarkable contrast to the ordinary nova, which has a brightness about one thousandth of this. In 1934 Baade and Zwicky suggested that these extremely bright objects were not ordinary novæ, but presented a class by themselves—the class of supernovæ. In the *Contributions from the Mount Wilson Observatory* (Nos. 600, 601 and 602), there is a comprehensive study of all these supernovæ from 1885 to 1938, and in these Baade deals with their photographic brightness at maximum, Baade and Zwicky with their light curves, and Minkowski with their spectra. It is remarkable that the absolute photographic magnitudes of the supernova and the spiral nebula in which it appears are nearly the same, on the average about $-14{\cdot}2$. The origin of such a cataclysm, producing a brightness of 7×10^7 suns, presents a problem on which it is possible to speculate, and which will probably exercise the minds of the theorists for some time. A supernova outburst is something entirely different from an ordinary nova outburst on a large scale, although there is a close similarity in the spectra. Certain differences, however, exist, and Minkowski, who has examined the bright bands in the later stages of the supernovæ, has not been able to identify them with certainty as belonging to known atoms or ions. The behaviour of the spectrum is peculiar, and it is very probable that the conditions under which matter is excited in supernovæ are most abnormal. Zwicky at the Palomar Observatory is undertaking a systematic survey with an instrument of large field, and since the autumn of 1936 has discovered seven supernovæ. It is hoped that sufficient material will soon be available for a study of these very interesting objects.

CYTOGAMY: A NEW SEXUAL PROCESS IN JOINED PAIRS OF PARAMECIUM CAUDATUM

By Dr. Ralph Wichterman, Temple University, Philadelphia

TWO sexual processes have been described for Paramecium in which three micronuclear (pregamic) divisions lead to synkaryon formation. One process, called conjugation (cross-fertilization), may be defined as the temporary union of two individuals involving three micronuclear divisions, *nuclear exchange* and the establishment of a new synkaryon in each conjugant.

The second process, called autogamy (self-fertilization) was described by Diller[1] for *Paramecium aurelia* as occurring in *single* animals only. Here three micronuclear divisions lead to the formation of gametic nuclei which fuse and form a synkaryon in the single animal.

I have observed a third sexual process in joined paramecia which appears to be intermediate to true conjugation on one hand and autogamy on the other. It resembles conjugation since two animals join together along their oral surfaces as in conjugation, but there is *no nuclear exchange* between the members. Instead, the three micronuclear divisions lead to the formation of the gametic nuclei, but a synkaryon is established in the *same individual* as in autogamy. I am therefore proposing a new term, *cytogamy*, for this phenomenon as distinct from autogamy in single individuals and true conjugation involving a nuclear transfer in joined pairs.

A new method of studying *living* joined *Paramecium caudatum* with a view of obtaining a better understanding of the problem of sexuality and nuclear behaviour was begun two years ago. By using a recently developed precision micro-compression chamber, it is possible to observe in the living condition the behaviour of nuclear phenomena over a fairly long period of time. In addition, accurate time relationships can be determined during the union. In this preliminary note, the method and observations may be stated briefly as follows:

With a micro-pipette, a single pair of recently joined paramecia is removed from a pedigree culture, placed in a small drop of culture fluid on the circular glass slide of the micro-compressor and studied at approximately 26° C. Extremely fine adjustments to within a few microns make it possible to prevent gradually the joined paramecia from spiralling between the two pieces of glass. When the joined animals move slowly, detailed observations may be made. In this manner, the divisions of the micronuclei and their behaviour have been seen and photographed on 35 mm. and 16 mm. motion picture film. The behaviour of the micronuclei in cytogamy closely parallels the described accounts of conjugation up to the stage of pronuclear exchange.

Cytogamous paramecia, which are considerably smaller than typical vegetative ones, are very insecurely attached to each other at their anterior ends at the beginning of the process. They can be separated very easily in the first hour or two of union. After they have been joined firmly, there is a progressive dedifferentiation of the ingestatory structures which appear to pass into a sol state. The micronucleus of each cytogamont leaves its place near the macronucleus and then gradually increases in size. This enlargement takes approximately 4–5½ hours, while the subsequent anaphase and telophase stages require only about 18 minutes.

The 'crescent' prophase stage and long anaphasic telophasic separation spindle, so characteristic in accounts of conjugation, is shown clearly. The swollen part at the centre of the separation spindle is passed into the cytoplasm (micronuclear chromatin extrusion) where active cyclosis moves this fragment about until it ultimately degenerates. Each product of the first micronuclear division enters into the second where again two long spindles in each individual are visible. This second division requires 50 minutes for completion from the time the first division products are formed. The anaphase and telophase stages take place still more rapidly, requiring only nine of the fifty minutes.

Micronuclear products, even while dividing, are moved about in the streaming protoplasm. Degeneration of three of the four products of the second division is observed. The remaining product enters into the third pregamic division, resulting in the formation of two pronuclei in each individual. The pronuclei of each single individual of the joined pair are seen to fuse and form a synkaryon in the *same individual*. No evidence has been obtained to indicate a transfer of pronuclei as is supposed to occur in conjugation.

To simulate normal conditions, the cytogamous paramecia are allowed to spiral freely except during those stages when critical observations are made. In fact, the joined paramecia may be removed from the small drop of culture fluid in the chamber and placed in a larger volume until a further observation is to be made, at which time they may be replaced in the chamber. On the other hand, the entire process may be observed in the micro-compression chamber. Since practically all the other stages of micronuclear behaviour can be verified with stained slides of joined paramecia, it seems very unlikely that the stage of nuclear transfer would be the only one affected by the relatively slight amount of compression to which they are subjected at certain times.

One is struck by the non-synchronous character of the nuclear activity in the individual members of a pair; that is, one member may show a nuclear stage definitely more advanced than that of its mate. This condition is seen occasionally. Recently Penn[2], using stained slides, also observed this phenomenon in a reinvestigation of the cytology of conjugation in *P. caudatum*. Although he believed he was studying conjugation, it appears very likely from his account and photographs that cytogamous individuals were seen instead. In such joined individuals, where the micronuclear divisions are out of phase with each other, the conclusion that there is a simultaneous pronuclear transfer which characterizes conjugation seems irrational.

After the individuals of a pair separate along their margins, a thin, clear, highly elastic strand holds the

organisms together. This strand, which finally breaks, consists of the fused and stretched apices of the paroral cones. Joined individuals may remain together for about 13½ hours at 26° C.

Diller writes, "Whenever conjugation is found in a culture, autogamy is likely to be taking place simultaneously; and conversely, when no conjugation is occurring in a culture, autogamy is unlikely to be seen". He says further that autogamous animals were "sticky" and more likely to stick to the wall of the pipette during transfers. It is very reasonable to suppose that Diller may have been observing pairs of individuals undergoing cytogamy instead of pairs undergoing conjugation as he believed.

Before this present work was undertaken, I was impressed by not being able to find clear and convincing cases of nuclear exchange after studying many slides of fixed and stained 'conjugating' paramecia from different sources. I believe now that I may have been studying cytogamous individuals and not true conjugants. The fact that a dividing third pregamic or maturation spindle presses against the contiguous membranes of joined paramecia is not evidence enough to enable one to infer pronuclear exchange, even though the membranes may appear to be stretched. It may indicate, however, that in a cytogamont, the membrane in this region of the paroral cone is very elastic.

In all my pedigree cultures, individuals when joining in cytogamy are never strongly attracted to each other as is so strikingly demonstrated in Sonneborn's[3] sex reaction of paramecia. In cytogamous union, they become rather feebly and insecurely joined in the beginning of the process; mass pedigree cultures left standing in the laboratory for approximately seven days after inoculation usually demonstrate this type of union with resulting cytogamy. Perhaps cytogamy takes place in single strains of *Paramecium* and true conjugation only when diverse strains are present.

Finally, my observations[4,5] have led me to question the work of others where a transfer of pronuclei is *presumed* to occur in "conjugation". The question may be raised as to how often joined cytogamous individuals in a culture of Paramecium (or even other ciliates) have been mistaken for true conjugation by investigators.

[1] Diller, W. F., *J. Morph.*, **59**, 11–67 (1936).
[2] Penn, A. B. K., *Arch. Protistenk.*, **89**, 45–54 (1937).
[3] Sonneborn, T. M., *Proc. Nat. Acad. Sci.*, **23**, 378–385 (1937).
[4] Wichterman, R., *Biol. Bull.*, **73**, 396–397 (1937).
[5] Wichterman, R., *Biol. Bull.*, **75**, 376–377 (1938).

THE MUSEUMS ASSOCIATION

JUBILEE CONFERENCE AT CHELTENHAM

AT its annual conference held at Cheltenham in the week commencing July 2, the Museums Association celebrated the fiftieth anniversary of its foundation. In his presidential address, the Right Hon. Viscount Bledisloe appropriately dealt with the state of museums fifty years ago and with the progress that has been effected in the intervening years. Speaking of the needs of the future, he suggested that at least one open-air folk museum might be established in England, for example, in the Forest of Dean. He also directed attention to the lack of any English museum illustrating agriculture.

In addition to a gracious message from its patroness, Her Majesty Queen Mary, the Association received many messages of greeting and congratulation from kindred societies, including the International Museums Office, the American Association of Museums, and the Internationaler Museenverband.

On behalf of the Standing Commission on Museums, Sir Albert Seward read an address prepared by Sir Evan Charteris; and an address from Mr. Arundell Esdaile, president of the Library Association, was also read.

Conveying the congratulations of the Royal Society of Arts, Lord Amulree, its chairman of Council, delivered an address on the museum as an aid to the encouragement of arts, manufactures, and commerce, in which he put forward the attitude of the Royal Society of Arts to the question of museums. He recalled that the Society held in 1760 the first important exhibition of contemporary art in England, and in the following year what was probably the first industrial exhibition in the world. The latter exhibition gave rise to "the Society's Repository or Model Room", which could be claimed as the first industrial museum. The part played by the Society in the establishment of the Science Museum, South Kensington, and its subsequent activities in this field were also discussed.

Prof. Anders Bugge conveyed greetings from the Norwegian Association of Museums, and Mr. E. C. Chubb and Mr. A. R. Penfold those of the South African and Australian and New Zealand Associations.

Sir Robert Witt, chairman of the National Art-Collections Fund, gave an account of the relations of that organization to the work of museums and art galleries.

One of the most important features of the Conference was an address by the Right Hon. Earl De La Warr, president of the Board of Education, on "Museums and Education", in which he referred to the great value of local museums in teaching the right use of leisure, and in assisting schools to develop the practical and realistic side of school work. The Board of Education is prepared to accept applications for grants from local education authorities for museum activities specially arranged for the benefit of school children. Museums deserve thanks for all the trouble they are taking in helping schools to-day, and encouragement towards still greater activities in the future.

An address which was received by all members with the very greatest enthusiasm was that given by His Excellency Don Salvador de Madariaga, chairman of the International Museums Office, on "Museums and World Peace". To visit an art museum and see a Velasquez, a Watteau, or a Constable is to appreciate the true character and inner thoughts of the

Spanish, French, and English nations. Art museums are of great importance in educating the emotions and in promoting a feeling of human unity. Their policy might be to bring out that power of man over matter which is opposed both to the exploitation of poverty and to the use of power over other men.

Speaking on "The Function of Natural History Museums", Dr. W. E. Swinton, of the British Museum (Natural History), referred to the great facilities for education in museums, but made a plea for the education of the adult as well as the child. A great deal of the so-called educational work done in museums is not related to their true function and could equally well be carried out by other institutions. The great value of natural history museums is to bring the visitor back to the basis of things. Dr. Swinton made a plea for simpler series of exhibits with fewer specimens (and preferably some that could be handled), and with clear explanatory labels.

A private meeting of the Association discussed air raid precautions in museums, and it is understood that the recent Government handbook on this subject received some criticism.

Among the other discussions held during the Conference was one initiated by Dr. John Rothenstein, director of the Tate Gallery, entitled "Towards a Policy for Art Galleries", and a long discussion on Mr. S. F. Markham's "Report to the Carnegie Trustees on the Museums of the British Isles".

In the course of various excursions, the long barrows of Belas Knap and Notgrove were inspected, as were the Roman Villa at Chedworth and the new Corinium Museum at Cirencester; also the Saxon Church at Deerhurst and Tewkesbury Abbey. Gloucester Cathedral and the Gloucester Museums were also visited. Garden parties were given by Viscount Bledisloe at Lydney Park and by Mr. Robert Holland-Martin at Overbury Court.

The Conference Exhibition was one of the largest ever held. As well as various trade stands, it included a collection of photographs by the Royal Institute of British Architects to illustrate contemporary museum architecture; examples of Cotswold crafts; an extensive display of material from the Leicester City and County Schools Loan Department of the Leicester Museum; two new loan cases prepared by the Victoria and Albert Museum and three by the Yorkshire Federation; and an exhibit by the Reading Museum of modern methods of casting.

At the annual meeting of the Association, honorary membership was conferred upon the Right Hon. the Earl of Harewood, M. E. Foundoukidis, Dr. E. E. Lowe, Mr. T. Sheppard, and Mr. William Wyndham, and the first diplomas under the Association's training and examination scheme were presented.

The next conference of the Association will be held at the Liverpool Public Museums in July 1940.

ASSOCIATION OF SHORT-CIRCUIT TESTING AUTHORITIES

DURING the last ten years, owing to the increase in the size of electrical power generating stations and of the machines they employ, together with the greatly increased voltages used for distribution, very difficult problems in switchgear technique and design have come to the front, which make it necessary to make a practical test of modern circuit-breakers of an unprecedented size. During an accidental short circuit, enormous currents may be generated, and if the circuit be not broken by suitable switchgear, great damage may be done to very expensive cables and generators. After intensive research, switchgear manufacturers realized that they must provide themselves with testing facilities on a very much larger scale than was hitherto in existence, in order that the apparatus manufactured should meet the new conditions satisfactorily, performing its functions, to the specified ratings, to the satisfaction both of user and manufacturer alike. The design of circuit-breakers has now become a specialized science.

The manufacturers have therefore erected high-power testing stations, fully provided with the most up-to-date equipment for the testing of circuit-breakers, fuses, reactors, transformers, etc. Without these facilities, manufacturers would have found it practically impossible to comply with the demands imposed upon them by the rapidly changing conditions in the supply industry. The owners of these high-power short-circuit testing stations soon realized that their separate endeavours would be of much greater benefit to the industry if the results of their experience and research in this highly specialized field could be pooled, and this resulted in the formation of the Association of Short-circuit Testing Authorities (ASTA). It is a company limited by guarantee and not having a share capital. In order to comply with the Board of Trade requirements, the articles of association provide (*a*) that the income and property of the Association shall be applied solely to the promotion of its objects as specified in a published memorandum, and (*b*) that no addition to the regulations contained in the articles of association can be made without the permission of the Board of Trade.

We have received from the head office of the ASTA, 36 Kingsway, London, W.C.2, an interesting illustrated publication giving general information on the short-circuit testing and certification of electrical apparatus. The names of eight of the largest electrical companies in England, which form this Association, are given. Prior to the formation of ASTA, individual owners of short-circuit testing plants had tested and certified the products of some manufacturers who had no testing facilities of their own. Other manufacturers held the view that there should be a national testing plant under the control of the National Physical Laboratory and a suggestion to this effect was made to the Home Office. The Department of Scientific and Industrial Research was asked to consider this suggestion, and, in reply to a questionnaire issued by the Department, the owners of short-circuit testing stations directed attention to the following points:

(1) That there are in existence or under construction short-circuit testing plants of a greater capacity than exist in any other country in which switchgear is being manufactured.

(2) That most of the manufacturers who have no testing plants would be satisfied if they could obtain

testing facilities for circuit-breakers of a maximum capacity of 250 million volt-amperes with a voltage limit of 11 kilovolts.

(3) That if the existing testing stations could place the necessary facilities at the disposal of the D.S.I.R., this seemed to be the most economical method of meeting the situation.

The Department saw the advantage from the national point of view of utilizing the existing facilities, and it has now been agreed that the ASTA will collectively place at the disposal of the D.S.I.R. facilities equivalent to one 'test bay' a year for testing circuit-breakers up to the agreed limits of capacity and voltage, and, further, that the D.S.I.R. will appoint a resident officer at any test plant where testing is being carried out, with a view to certification of the results by the National Physical Laboratory. These arrangements will enable the N.P.L. on request to undertake, supervise and certify the results of tests of switchgear manufactured by non-members of ASTA. Manufacturers wishing to have short-circuit tests carried out by the Association with a view of obtaining a certificate from the N.P.L. should apply in the first instance to the director of the National Physical Laboratory, Teddington, Middlesex.

The testing stations are at Hebburn-on-Tyne, Trafford Park (Manchester), Stafford, and Witton, Birmingham. The generators are of unusual design, capable of short-time rated outputs in excess of the normal outputs of the largest power stations, and mechanically constructed to withstand the stresses resulting from repeated short circuits. The privacy of all tests is rigidly ensured, but a reasonable number of persons nominated by a client are welcome to witness them. Members of the Association do a considerable amount of research work, not only for manufacturers, but also in the general interests of the electrical industry.

'TIME-OF-DAY' ELECTRIC TARIFFS

DURING the last few years, electrical engineers have given much study to the development of tariffs for electric power which will benefit both consumer and producer and lead to an increased demand for their product. Dr. Hopkinson pointed out fifty years ago that a steady load could be generated much more cheaply than a variable load, although their total loads for a given time were the same. This follows because with a steady load you require less machines in reserve than you do when there are peaks in the load for which much reserve plant is required which is only used for a comparatively short time. The total annual costs of a supply station depend on the running costs and the overhead costs, the former usually being only about one eighth of the latter. Hence any saving in the capital costs of the reserve plant enables appreciable savings to be divided between producer and consumer and would probably attract new consumers. One way of securing a uniform load is by means of a 'time-of-day' tariff. The rate at which the meter registers could be controlled by a ripple current superimposed on the supply current. The ideal case of continuous variation would be difficult, but if the rate at which the meter registers was changed at the supply station two or three times a day, the consumers being notified of the times of these changes, most of them would naturally be careful to keep down their consumption during the times when the meter was registering a high charge. This would increase the 'diversity' of the load and make it more uniform, thus lowering the station cost.

At first sight, this seems unpractical and far-fetched, but as several European cities use a 'time-of-day' tariff the discussion of one of these methods given in a paper by D. J. Bolton of the Regent Street Polytechnic, to the Institution of Electrical Engineers, on May 10, entitled "Superimposed Control Applications with Special References to Tariffs and Load Levelling", is worth studying.

The following are the details of the tariff of a Paris company. Consumers are divided into groups according to the 'size' of their installation. The size is defined by the maximum power consumption and depends on the number of rooms. The charge is 2 kw. per day for a one-room apartment, 3 kw. per day for two to four rooms, 4 kw. for five to six rooms, etc. Consumers whose power demand is less or equal to this amount are supplied through a single dial meter, and are charged at the following rate. If the first 'block' of the amount is charged at 3*d*. a unit, the second block will be charged at 1½*d*. per unit, and the remainder at 0·54*d*. per unit. The size of the first block is dependent on the number of rooms, and the second block size is always half the first block size. Large consumers can have supplies on a two-part tariff consisting of a small fixed charge to cover lighting consumption and a running charge varying with the time of the day. The fixed charge depends on the number of rooms and ranges from 11*s*. to £2 a year for a one to six room flat. In addition to this fixed charge, all the energy passes through a special meter having three registrations. These are put into operation at appropriate times of the day by means of timed relays on a centralized control system.

A Paris company was started in 1924 at a special rate for off-peak consumption but was changed into the three-rate tariff system outlined above. This tariff is little used in the purely domestic field, but there is a definite and growing utilization of it in the commercial field for large-scale cooking, oven heating and thermal storage. There would probably soon be a growing demand for it for domestic purposes, if the cost of the special metering required were reduced. This Paris company's charges for the peak period are 2·5*d*. per unit. This period lasts from 3 until 6 p.m. during the winter months. For the 'day' period, which lasts from 7 until 11 a.m. and 2 until 3 p.m. in the winter months and from 2 until 6 p.m. in summer, the price is 1·3*d*. per unit, and for the night period and all other times it is 0·53*d*. per unit.

Mr. Bolton concludes that the function of a 'time-of-day' tariff in Great Britain, both in the commercial and domestic field, would be to develop new loads not yet reached. It should supplement rather than supplant existing methods of charge.

SCIENCE NEWS A CENTURY AGO

Laying the Keel of the *Great Britain*

ON July 19, 1839, the keel of the *Great Britain* was laid in a dock at Bristol. This marked the beginning of the construction of by far the largest iron ship of the time. Like the *Great Western*, she was built for the Great Western Steamship Co., for work on the Atlantic. Her construction was due to the collaboration of Isambard Kingdom Brunel, Thomas Richard Guppy, William Patterson and Captain Christopher Claxton, R.N. At first it was intended to build the ship of wood, but the unusual size led to the adoption of iron. The largest iron vessels afloat were only of about 700 tons, but when completed the *Great Britain* had a displacement of 3,618 tons. She was 289 ft. long between perpendiculars, 50½ ft. wide and 32½ ft. deep. Her flat keel was made of wrought iron plates ⅞ in. thick and 20 in. wide, welded into lengths of 50–60 ft. Her stern and stem frame were both wrought iron forgings. The ship had five watertight bulkheads. Before the ship was commenced, Claxton and Patterson made a careful study of iron for shipbuilding. They found that iron afforded greater strength, buoyancy and capacity, and that iron beams 2½ in. thick would have the strength of wooden beams 2 ft. thick. The *Great Britain* was not only the largest iron ship, but the largest wrought iron structure for any purpose.

Re-discovery of the Aurora Islands

THE *Athenæum*, in its accounts of the papers read to the Royal Geographical Society on June 24, 1839, included references to the voyages of the *Medina* and *Mary* belonging to Mr. Burrows of New York, who on a recent expedition had re-discovered the Aurora Islands, which lie half way between the Falkland Islands and South Georgia. In its issue of July 20, 1839, the journal said: "A letter from our United States Correspondent gives us some particulars of this expedition which are romantic enough to deserve to be recorded. It appears that some four years since a neighbour and friend of Mr. Burrows, a Capt. Johnson, after consulting with and communicating to him his views and intentions, sailed from New York to the Antarctic Seas. Letters were received from Johnson when in a high latitude, and still sailing south, since which no information has been received either from or of him. These circumstances weighed upon the mind of Burrows, who thinking there was a possibility of rescuing his friend, resolved to follow the example of Capt. Back, and to proceed in search of him. Two small vessels were accordingly fitted out for the expedition. The success in the principal object has been small, although the hazards run were great and the labour most oppressive." When beyond the Falklands icebergs were met with. "Subsequently Mr. Burrows, when exploring in his boat, was wrecked on an iceberg, but he was rescued by another boat driven by accident to the spot, where for three days he and his crew had been without food. For six months he persevered, but without discovering any positive evidence of the fate of his friend. He found, indeed, clear traces of eight different wrecks, a house constructed from the wrecked vessels and fitted up as a winter residence; several graves were near it, and one body not interred. What a history 'in little' is there in this last fact."

A Uranian Society

IN July 1839, a preliminary meeting was held in the Meteorological Society's rooms, Bartlett's Buildings, Holborn, for the purpose of founding a society for the advancement of astronomical science. The society was to be called "The Uranian Society". According to the *Mechanic and Chemist*, Mr. W. H. White, F.R.S., the senior secretary of the Astronomical Society, presided at the meeting. Various resolutions were passed relating to membership, subscriptions, committee and officers, and it was agreed "that the anniversary of this society be held on the 22nd of March, that being the birthday of the immortal Laplace".

Sepulchral Urn

THE *Gentleman's Magazine* for July 1839 contains the following information: "A curious discovery has recently been made on the ridge of hill which divides the Vale of Ovoca from the Vale of Redcross near Kilbride, County of Wicklow. The ridge of the hill affords many remains of remote antiquity, some are blocks of stone 15 ft. in length, laid parallel to each other, resembling burying places made for men of gigantic stature. A farmer was raising stones in a wild and solitary part of the mountains to fill up gaps; about two feet below the surface he turned up a flag, under which was a stone coffin, containing an urn in an inverted position, under which were two small bones laid parallel to each other. The coffin, consisting of six flags, was eighteen inches long, the sides were seven inches high, and ten broad, put together with neatness, the corners rectangular and the sides perpendicular; the inside perfectly clean and free from dust or mould. The urn was four inches deep, swelling in the middle, and contracting at both ends."

UNIVERSITY EVENTS

ABERDEEN.—At the graduation ceremony held on July 6, the honorary degree of LL.D. was conferred on Prof. C. L. Burt, professor of psychology in the University of London, and on Prof. A. Low, professor of anatomy in the University of Aberdeen from 1925 until 1938.

The degree of D.Sc. was conferred on Dr. J. Farquharson, for a thesis entitled "Magnetism and Polymerisation"; L. C. Snook, for a thesis entitled "The Effect of Diet on Ketonemia and Pregnancy Disease in Breeding Ewes"; and on H. Waring, for a thesis entitled "The Relation of the Pituitary Gland to the Chromatic Function of Fishes" (*in absentia*).

ST. ANDREWS.—The degree of M.A. *ad eundem gradum* has been conferred on Dr. E. Finlay Freundlich, Napier lecturer in astronomy. The degree of D.Sc. has been awarded to Dr. J. D. Robertson for a thesis entitled "The Nature and Movements of Interstitial Fluids and Aqueous Humour".

Dr. F. L. Arnot, whose work on ionization in gases has been approved for the degree of Sc.D. by the University of Cambridge, has resigned his post as lecturer in natural philosophy in the United College, having been appointed to a lectureship in his old University of Sydney, New South Wales.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

GRADUATE LECTURER IN ENGINEERING at Lincoln Technical College—Director of Education, City Education Office, Lindum Road, Lincoln (July 19).

LECTURER IN CHEMISTRY (Organic) at King's College, Newcastle-upon-Tyne—Registrar (July 19).

TEACHER OF MINING SUBJECTS at Leigh Municipal College—Director of Education, Education Department, Town Hall, Leigh, Lancs (July 20).

DIETITIAN at the Middlesex Hospital, W.1—Secretary-Superintendent (July 22).

ASSISTANT TECHNICAL ADVISERS in the Engineering Branch of the Air Raid Precautions Department—Establishment Officer, Home Office, Whitehall, S.W.1 (quoting Technical Adviser) (July 22).

LECTURER IN MECHANICAL ENGINEERING—Secretary, Robert Gordon's Technical College, Aberdeen (July 22).

ASSISTANT III (ENGINEER) at the Fuel Research Station, East Greenwich—Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (quoting J. 39/9) (July 24).

HEAD OF THE CHEMISTRY DEPARTMENT in the Municipal Technical College, Bolton—Director of Education, Education Offices, Nelson Square, Bolton (July 24).

ASSISTANT LECTURER IN ELECTRICAL ENGINEERING at York Technical Institute—Secretary for Education, Education Offices, York (July 24).

TWO ASSISTANT MARKETING OFFICERS—Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (July 24).

LECTURER IN PHYSIOLOGY—Secretary, King's College, Strand, W.C.2 (July 25).

ASSISTANT MASTER TO TEACH PHYSICS—Headmaster, Royal Navy College, Dartmouth (July 25).

LECTURER IN METALLURGY AND CHEMISTRY in the Technica College, Coventry—Director of Education, Council House, Coventry (July 26).

CHEMISTS AND ASSISTANTS III in the Royal Ordnance Factories—Under-Secretary of State (C. 5), War Office, S.W.1 (quoting Appts. 156) (July 27).

CARTOGRAPHERS (Unestablished) in the Hydrographic Department of the Admiralty—Secretary, Civil Service Commission, Burlington Gardens, W.1 (July 27).

LECTURER IN ENGINEERING at the Cape Technical College, Cape Town—J. A. Ewing and Co. (London), Ltd., 73–74 Chiswell Street, E.C.1 (July 28).

PUBLIC ANALYST AND GOVERNMENT BACTERIOLOGIST in the Isle of Man—Government Secretary, Government Office, Isle of Man (August 1).

TEMPORARY ASSISTANTS GRADE III (Male) in the Meteorological Office—Under-Secretary of State, S.2.B. (Met.), Air Ministry, Adastral House, Kingsway, W.C.2 (August 14).

PRINCIPAL AGRICULTURAL OFFICER in the Federated Shan States, Burma—High Commissioner for India, General Department, India House, Aldwych, W.C.2 (quoting Appointment 5/153B) (August 14).

ASSISTANT LECTURER IN ENGINEERING—Registrar, University, Manchester 13 (August 14).

LECTURER IN NATURAL PHILOSOPHY in the United College, St. Andrews—Secretary, University, St. Andrews (August 15).

SENIOR LECTURER IN BANTU STUDIES at Rhodes University College, Grahamstown—Secretary, Office of the High Commissioner for South Africa, Trafalgar Square, W.C.2 (August 17).

ASSISTANT MISTRESS TO TEACH PHYSICS—Principal, Ladies' College, Cheltenham.

ASSISTANT ENGINEER for the Drainage and Irrigation Department, Malaya—Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/5765).

MECHANICAL AND AUTOMOBILE ENGINEERS in the Royal Army Ordnance Corps—Under-Secretary of State (A.G. 9), War Office, S.W.1.

TECHNICAL OFFICERS AND ASSISTANTS II AND III at various Royal Air Force Stations—Under-Secretary of State, Air Ministry (S.2. A/B. 8019), Berkeley Square House, Berkeley Square, W.1.

CIVILIAN EDUCATION OFFICERS, Grade III, in the Royal Air Force Educational Service—Under-Secretary of State, Air Ministry (E.S.1) (E. and M.), Adastral House, Kingsway, W.C.2.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Hull Museum Publications. No. 202: The Old Dutch Whalers. By Thomas Sheppard. Pp. 20. No. 203: Viking and other Relics at Crayke, Yorkshire. By Thomas Sheppard. Pp. 12+6 plates. No. 204: Prehistoric East Yorkshire, Early Valentines, and Record of Additions. Edited by Thomas Sheppard. Pp. 42. (Hull: Hull Museum.) [266

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1938. Pp. iv+549+5 plates. (London: H.M. Stationery Office.) 12s. 6d. net. [276

North of Scotland College of Agriculture. Guide to Experiments and Demonstration Plots at Craibstone, 1939. Pp. xii+65. (Aberdeen: North of Scotland College of Agriculture.) [276

Other Countries

Proceedings of the U.S. National Museum. Vol. 86, No. 3052: Species of the Foraminiferal Family Camerinidae in the Tertiary and Cretaceous of Mexico. By R. Wright Barker. Pp. 305–330+plates 11–22. (Washington, D.C.: Government Printing Office.) [206

The South African Journal of Science. Vol. 35: Being the Report of the South African Association for the Advancement of Science, 1938, Pietermaritzburg. Pp. xx+514. (Johannesburg: South African Association for the Advancement of Science.) 30s. net. [206

Institut de France. Académie des Sciences Annuaire pour 1939. Pp. 196. Index biographique des Membres et Correspondants de l'Académie des Sciences de 1666 à 1939. Pp. x+478. (Paris: Institut de France. [206

Comité National français de Géodésie et Géophysique. Exploration gravimétrique de l'extrême-orient. Par le R. P. Pierre Lejay. Pp. 76. Exploration gravimétrique des états du levant sous mandat français. Par le R. P. Pierre Lejay. Pp. 54. (Paris: Comité National français de Géodésie et Géophysique.) [206

Geological Survey of British Guiana. Bulletin No. 10: Report on the Aranka Goldfield, Cuyuni River. By Dr. D. A. Bryn Davies. Pp. iii+25+3 plates. (Georgetown: Government Printers.) 24 cents. [216

Newfoundland Government: Department of Natural Resources. Research Bulletin No. 6: The Occurrence and Biological Features of Haddock in the Newfoundland Area. By Dr. Harold Thompson. Pp. 32. (St. John's: Department of Natural Resources.) 20 cents. [216

Spectrochimica Acta: ein Forschungsarchiv. Band 1, Heft 1. Pp. 92. (Berlin: Julius Springer.) 8.60 gold marks. [226

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 21, No. 8 (Mathematics No. 36): Beitrige zur Geometrie der Kreise und Kugeln (29), von Sôzi Matumura: Über Flächen und Kurven (20), von Sôzi Matumura. Pp. 253–318. (Taihoku: Taihoku Imperial University.) [226

Report of the First Scientific Expedition to Manchoukuo, under the Leadership of Shigeyasu Tokunaga, June–October 1933. Section 5, Division 1, Part 1: Trematode Parasites of Jehol; Chaetopoda of Jehol; Hirudinea of Jehol; Mollusca of Jehol and District North of It. Pp. 345+45 plates. Section 5, Division 1, Parts 5, 7, 9, 11, 13: Insects of Jehol (1, 3, 5, 7, 9). Pp. 361+49 plates. (Tokyo: Waseda University.) [226

Smithsonian Miscellaneous Collections. Vol. 98, No. 13: The Polychaetous Annelids Collected on the Presidential Cruise of 1938. By Olga Hartman. (Publication 3538.) Pp. 22. Vol. 98, No. 14: A New Dicrocoelid Trematode Collected on the Presidential Cruise of 1938. By Allen McIntosh. (Publication 3541.) Pp. 4. (Washington, D.C.: Government Printing Office.) [226

Report for the Year 1938 of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty. Pp. 17. (Cape of Good Hope: Royal Observatory.) [266

Spektral-Durchmusterung von Milchstrassenfeldern. Von A. A. Wachmann. Teil 1. Pp. E 38+68. Viertes Bergedorfer Sternverzeichnis 1950·0. Von F. Dolberg und J. Larink. Pp. 22. Astronomische Abhandlungen, Band 5, Nr. 1: Untersuchungen über Gesetzmässigkeiten des Lichtwechsels der RR. Lyrae-Sterne. Von Elisabeth Kleissen. Pp. 18. Jahresbericht der Hamburger Sternwarte in Bergedorf für das Jahr 1938. Erstattet von dem direktor, Dr. R. Schorr. Pp. 24+4 plates. (Bergedorf: Hamburger Sternwarte.) [266

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 125: A Soil Survey of part of the Kerang Irrigation District, Victoria. By J. G. Baldwin, G. H. Burvill and J. R. Freedman. Pp. 44. (Melbourne: Government Printer.) [266

Annuario della Società Reale di Napoli. Anno 17 (29 ottobre 1938–28 ottobre 1939). Pp. 120. (Napoli: Società Reale.) [266

Smithsonian Miscellaneous Collections. Vol. 98, No. 6: Decapod and other Crustacea Collected on the Presidential Cruise of 1938 (with Introduction and Station Data). By Waldo L. Schmitt. (Publication 3531.) Pp. 30+3 plates. Vol. 98, No. 10: Mollusks Collected on the Presidential Cruise of 1938. By Paul Bartsch and Harald Alfred Rehder. (Publication 3535.) Pp. 18+5 plates. Vol. 98, No. 12: A New Holothurian of the Genus Thyone Collected on the Presidential Cruise of 1938. By Elisabeth Deichmann. (Publication 3537.) Pp. 7. (Washington, D.C.: Smithsonian Institution.) [276

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Meteorological Instruments. (Catalogue No. 633.) Pp. 130. (London: C. F. Casella and Co., Ltd.)

Musik: Praktisch, Historisch, Theoretisch. Teil 4: Royer—Zwickauer Gesangbuch, Nachtrag. (Antiquariats-Katalog Nr. 54.) Pp. 337–448. (Leipzig: Karl Max Poppe.)

Water Heater Thermostat. (Leaflet No. 152–2.) Pp. 2. The Simmerstat Control for Cooker Hotplates and Radiant Boiling Rings. (Leaflet No. 153–1.) Pp. 4. (London: Sunvic Controls, Ltd.)

Cambridge Automatic Regulators. (Folder No. 68.) Pp. 6. (London: Cambridge Instrument Co., Ltd.)

The Wild-Barfield Heat-Treatment Journal. Vol. 3, No. 21, June. Pp. 52–64. (London: Wild-Barfield Electric Furnaces, Ltd.)

The Nivoc Supplement. No. 8, Series E, June. Pp. 12. (London: W. and J. George, Ltd.)

The Askania Review. No. 8, June. Pp. 40. (Berlin-Friedenau: Askania-Werke A.G.)

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